African Invertebrates Vol. 43 Pages 143–181 Pietermaritzburg December, 2002

Revision of some of the oldest species in the millipede genus *Sphaerotherium* Brandt, 1833 (Diplopoda, Sphaerotheriida, Sphaerotheriidae), with new synonymies

by

Didier Van den Spiegel[1], Sergei I. Golovatch[2] and Michelle L. Hamer[3]

([1]Royal Museum for Central Africa, Invertebrate Section, Tervuren 3080, Belgium; dvdspiegel@africamuseum.be; [2]Institute for Problems of Ecology and Evolution, Russian Academy of Sciences, Leninsky pr. 33, Moscow 117071 (V-71), Russia; sgol@orc.ru; [3]School of Botany and Zoology, University of Natal, P. Bag X01, Scottsville 3209, KwaZulu-Natal, South Africa; hamerm@nu.ac.za)

Dedicated to J. F. Brandt (1802–1879), the pioneer
student of South African Diplopoda,
on the occasion of his 200th anniversary

ABSTRACT

During a study of *Sphaerotherium* samples from South Africa, the underside of the posterior margin of the tergites was found to yield some important taxonomic characters that appear remarkably stable both in the male and female, as well as between stadia and tergites. The opportunity is taken here to revise most of the oldest *Sphaerotherium* species, with special reference to the structure of the posterior tergal margin. All available type material of the species described by Brandt, Gervais, C. L. Koch, Porat and Karsch have been revised, with the following synonymies established or confirmed: *S. klugii* Brandt, 1841, *S. repulsum* Karsch, 1881, *S. trichopygum* Attems, 1908 and *S. ancillare* Attems, 1928 = *S. compressum* Brandt, 1833; *S. microstictum* Brandt, 1841 = *S. elongatum* Brandt, 1833; *S. retusum* C. L. Koch, 1847 = *S. dorsale* Gervais, 1847, and *S. grossum* C. L. Koch, 1847 = *S. obtusum* C. L. Koch, 1847. As the subgenera *Neobournellum* Attems, 1908 and *Tetraconosoma* Verhoeff, 1924 appear to be strict junior subjective synonyms of *Sphaerotherium s. str.*, to replace *Sphaerotherium auct.* the genus-group name *Bournellum* De Saussure & Zehntner, 1902 is revived as currently the earliest available substitute, with the type species *Sphaerotherium retusum* C. L. Koch, 1847 showing ≥7 sensory cones on the last antennomere. A neotype of *Oligaspis puncticeps* Wood, 1865 has been selected, and the species is shown to be a new junior subjective synonym of *S. rotundatum* Brandt, 1833.

INTRODUCTION

The pill millipede order Sphaerotheriida is a modestly diverse higher taxon of Diplopoda. With its about 230 described species, largely in tropical or subtropical environments, the order shows a disjunct distribution which includes southern Africa, Madagascar, the Seychelles Islands, the entire Oriental Region, the eastern part of Australia, Tasmania and New Zealand. Despite such a vast distribution and often conspicuous appearance, the bulk of sphaerotheriidan species are very poorly known, with many genera also requiring revision (Hoffman 1980).

Jeekel (1974) proposed a new classification based primarily on female sexual characters. He noticed that, within certain geographical areas, there is remarkable stability in certain traits of the vulvae, or cyphopods. Two almost equally diverse families have thus been defined: the apparently more advanced Sphaeropoeidae covering the Oriental realm plus Malesia, and the obviously more basal and widespread Sphaerotheriidae. Based largely on cyphopod structure, both families have been split into a number of tribes, each also characterised by its own coherent distribution pattern (cf. Hoffman 1980). Within the Sphaerotheriidae, four tribes are accepted, i.e. the Sphaerotheriini representing the order in southern Africa, the Zoosphaeriini in Madagascar, the Arthrosphaerini in peninsular India and Sri Lanka, and the Cyliosomatini in Australia, Tasmania, New Zealand and the Seychelles. In the females of Sphaerotheriini, the bursa embraces the operculum at its medial and lateral edges, showing a characteristic shape of the vulva (Jeekel 1974), while the males have a well-developed stridulatory apparatus on the posterior telopods consisting of several strongly chitinised ridges (Bourne 1885).

The genus *Sphaerotherium* Brandt, 1833, as currently defined, comprises more than 60 described species or subspecies, and, composing the Sphaerotheriini together with the monotypic *Kylindotherium* Attems, 1928, it constitutes one of the most conspicuous and diverse elements in the diplopod fauna of southern Africa (Hamer 1998), up to Malawi in the north. Yet *Sphaerotherium* has long been acknowledged as being badly confused taxonomically. The confusion, however, is not in distinguishing congeners (Silvestri 1910; Attems 1928; Schubart 1958). Ever since Brandt (1833 1841*a*), who alone described 12 species of *Sphaerotherium* (cf. Golovatch & Hoffman 2001), almost no revisions have been attempted. The descriptions of most of the congeners proposed by and since Brandt, largely reviewed by Attems (1928), Schubart (1958) and listed by Hamer (1998), appear to be highly superficial, hence absolutely insufficient for species recognition. The confusion is even more profound, because only male telopods or female vulvae have hitherto been considered as the paramount and most reliable taxonomic characters, with the result that many species have been described on one sex only. Peripheral characters like body coloration, tergal sculpture/texture, pilosity, and protuberances or excavations, have largely been treated as subordinate (cf. Schubart 1958), while the number of sensory cones on antennomere 8, i.e. four versus numerous, has been used as a subgeneric character. To exacerbate the situation, many of the types are presumably lost, most of the oldest extant types are in poor condition, and some of the series of syntypes have been shared between two or more museum collections (cf. Moritz & Fischer 1973; Golovatch & Hoffman 2001). In addition, many of Attems' male types housed in South African museums appear to lack the telopods, apparently removed by Attems during dissection and currently being sought as micropreparations or microvials in the Vienna Museum. All this virtually blocks any further taxonomic work on *Sphaerotherium*.

The underside of the posterior tergal margin has long been used in the systematics of *Sphaerotherium* (e.g. Silvestri 1910; Attems 1928; Schubart 1958), but mainly as a subordinate character because the degree of variation remained unclear. In the course of a preliminary study of *Sphaerotherium* material from southern Africa, one of us (DVDS) noticed that the taxonomic features associated with the tergal margin appear remarkably stable between the male and female as well as between the stadia and tergites. The opportunity is taken here to revise most of the oldest *Sphaerotherium* species with special reference to the posterior margin of the terga. This provides important characters, so we believe it deserves its own name. We follow Hoffman (pers. comm.), who coined the term "endotergum" to describe this structure.

In addition, one of the main objectives of this contribution was to commence with a character matrix for the revised and confirmed *Sphaerotherium* species.

MATERIAL AND METHODS

The bulk of material treated in the present paper consists of the types of Brandt (1833 1841*a*), Gervais (1847), C. L. Koch (1847), Porat (1872) and Karsch (1881), as well as two species of Attems (1908 1928), still available in the collections of the Berlin, Cape Town, Paris, Stockholm and St. Petersburg museums, with some fresh samples from the London, Natal, Transvaal and Tervuren museums also incorporated. Scanning electron microscopy (SEM) was used to reveal some fine structures. The SEM samples were dried and mounted on aluminium stubs, coated with gold in a sputter coater and observed with a JEOL JSM-5400LV scanning electron microscope. All measurements, except those on SEM micrographs, are in mm.

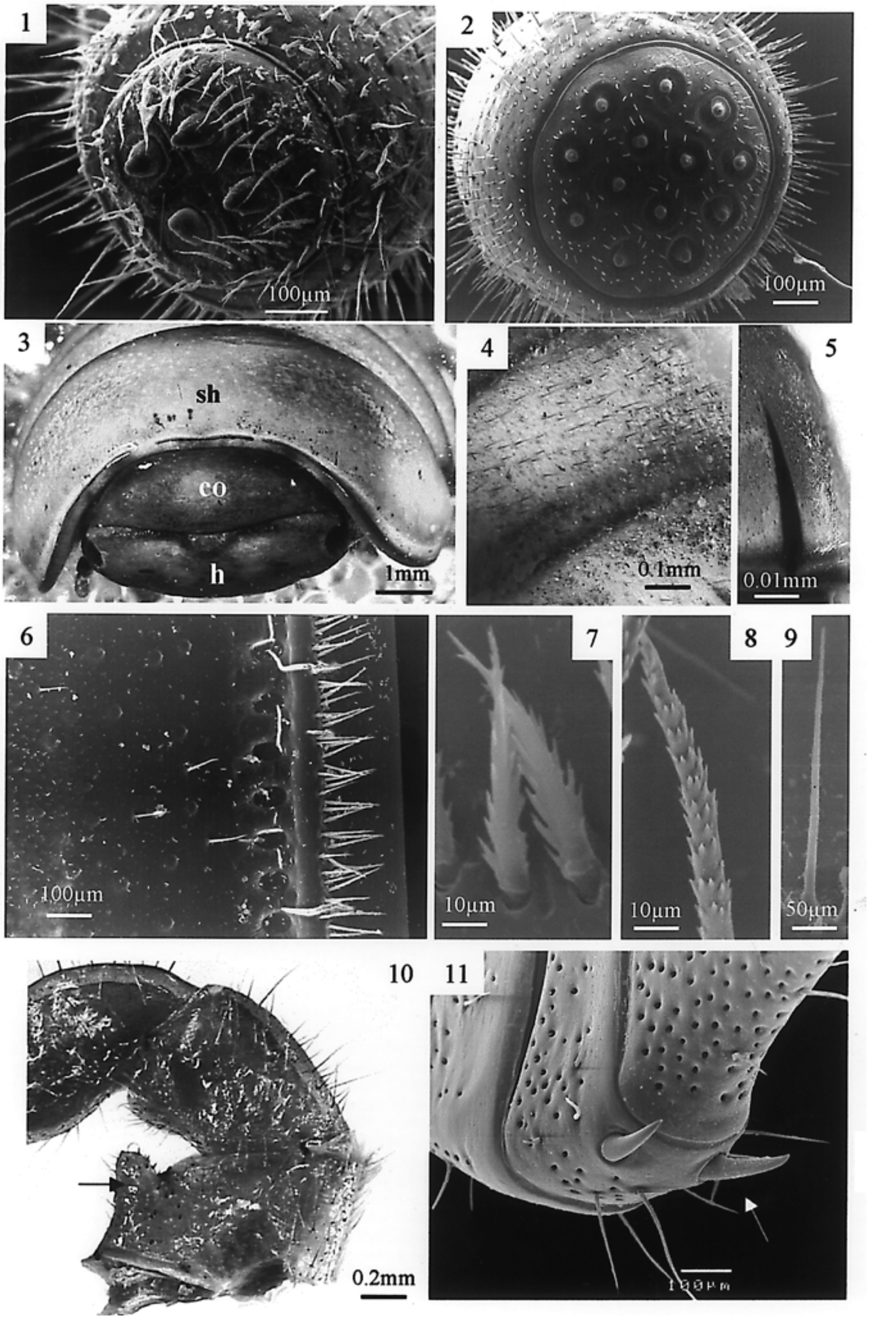
Abbreviations used are as follows:

E. Cape	Eastern Cape
F	female
IEPN	Istituto di Entomologia Generale ed Agraria in Portici, Napoli, ltaly
KNP	Kruger National Park, South Africa
LP	Limpopo
M	male
MHNP	Museum National d’Histoire Naturelle, Paris, France
MRAC	Musée Royal de l’Afrique Centrale, Tervuren, Belgium
MZLU	Lund Universitets Zoologiska Museum, Sweden
N. Cape	Northern Cape
NHML	Natural History Museum, London, UK
NMSA	Natal Museum, Pietermaritzburg, South Africa
NWP	North West Province
RSA	Republic of South Africa
SAMC	South African Museum, Cape Town, South Africa
SEM	Scanning electron microscopy
SMNH	Swedish Museum of Natural History, Stockholm, Sweden
TMSA	Transvaal Museum, Pretoria, South Africa
W. Cape	Western Cape
ZISP	Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia
ZMB	Museum für Naturkunde der Humboldt-Universität, Berlin, Germany

SYSTEMATICS

Sphaerotherium Brandt, 1833

Sphaerotherium Brandt, 1833: 198.
Sphaerotherium: C. L. Koch, 1847; Pocock, 1895; Attems 1928, 1934; Schubart 1958; Jeekel, 1974; Hoffman, 1980.
Oligaspis Wood, 1865*a*: 173. Type species: *Oligaspis puncticeps* Wood, 1865*a*, by monotypy.
Bournellum De Saussure & Zehntner, 1902: 20. Type species: *Sphaerotherium retusum* C. L. Koch, 1847, by subsequent designation of Jeekel, 1970: 23.
Eubournellum Attems, 1908: 426. Type species: *Sphaerotherium retusum* C. L. Koch, 1847, by subsequent designation of Jeekel, 1970: 25.
Neobournellum Attems, 1908: 426. Type species: *Bournellum trichopygum* Attems, 1908, by monotypy.
Natalobelum Verhoeff, 1924: 59. Type species: *Sphaerotherium punctulatum* Brandt, 1841, by monotypy.
Tetraconosoma Verhoeff, 1924: 57. Type species: *Sphaerotherium weberii* Silvestri, 1910, by subsequent designation of Jeekel, 1970: 29.



Figs 1–11. Some structural details in *Sphaerotherium* species. 1–2. Apical part of antenna in subgenus *Sphaerotherium* and "*Bournellum*" respectively. 3. Head, collum and thoracic shield of a *Sphaerotherium* species. 4–5. *S. retusum*. 4. Tergal structure. 5. Median keel. 6–7. *S. rotundatum*. 6. Midbody endotergum. 7. Two marginal bristles. 8. *S. punctulatum*, marginal bristle. 9. *S. compressum*, marginal bristle. 10. Coxal lobe of 9th leg in *S. obtusum* (arrow). 11. *S. rotundatum*, detail of leg 9 showing tibial spines (arrow).

Type species: *Sphaerotherium rotundatum* Brandt, 1833, by subsequent designation of Pocock (1895: 410).

Diagnosis: A genus of Sphaerotheriidae restricted to southern Africa, characterised by the structure of the main stridulatory organ of the male consisting of a striated cushion, borne by the tibia of the posterior telopod, and its corresponding patch of granules on the underside of the pygidium. Females with vulva consisting of three pieces.

Morphology:

Antennae:

Short, clavate and setose. Apical antennomere (8th) represented either by 4 (5) or 7 to ≥60 sensory cones. As already mentioned by previous authors (Verhoeff 1924; Attems 1928 1943; Schubart 1958), the number of sensory cones is a taxonomic character. Previously it allowed the division of the genus into two rather clearly distinguishable groups usually treated as subgenera: *Sphaerotherium s. str.* (= *Tetraconosoma*, the latter name now treated as a junior synonym, see below under *S. rotundatum*) with four, rarely five, sensory cones (Fig. 1) and "*Bournellum*" (replacement name for *Sphaerotherium sensu auctorum*, see below under *S. rotundatum*) with seven or more sensory cones (Fig. 2). However, such a subgeneric division is abandoned (see below under *S. dorsale*).

Collum and thoracic shield:

The collum and thoracic shield (Fig. 3), or the first and second tergites, respectively, are often used in *Sphaerotherium* taxonomy, but according to our observations, both offer very little taxonomic information.

Tergites:

The surface of the tergite varies from entirely smooth to densely punctate-pilose (Fig. 4). Generally, the pilosity is minute and difficult to see, but in some species it is longer; in *S. dorsale* the hairs are very dense and quite long, giving the body surface a furry appearance (Fig. 4). On the anterior part of terga 2–12, several species show a somewhat elevated midline, termed a median keel (Fig. 5), which is broader in front, narrowing and disappearing approximately midway along the segment. Although the keel is only rarely well expressed, as in *S. dorsale*, more commonly it is obscure or small, and in some species, like *S. compressum*, it is particularly small and discrete.

The tergal underside is also important taxonomically, as it offers some relevant taxonomic characters, like (a) the intersegmental membrane, (b) the marginal ridge, and (c) the marginal bristles (Figs 6, 12):

(a) The intersegmental membrane, i.e. the membrane connecting two body segments, shows two kinds of outgrowth: (i) dark cones, pointed or blunt, which are the membrane's only thickenings, and (ii) bristles which can be long or short (Figs 6, 12c).

(b) The underside of the tergal margin, or endotergum, bears a ridge, termed a marginal ridge, some distance from and parallel to the posterior margin; the surface of this ridge often shows a row of callosities (marginal callosities), and parallel to the callosities, a row of cuticular patterns (Fig. 12b).

(c) Close behind these callosities is a row of bristles (marginal bristles) arranged in one (*S. compressum*) or several (*S. elongatum*) rows, sometimes partly between the marginal callosities. The bristles are pinnate (*S. rotundatum*, *S. elongatum*, Fig. 7), scaly (*S. punctulatum*, Fig. 8) or smooth (*S. compressum*, Fig. 9).

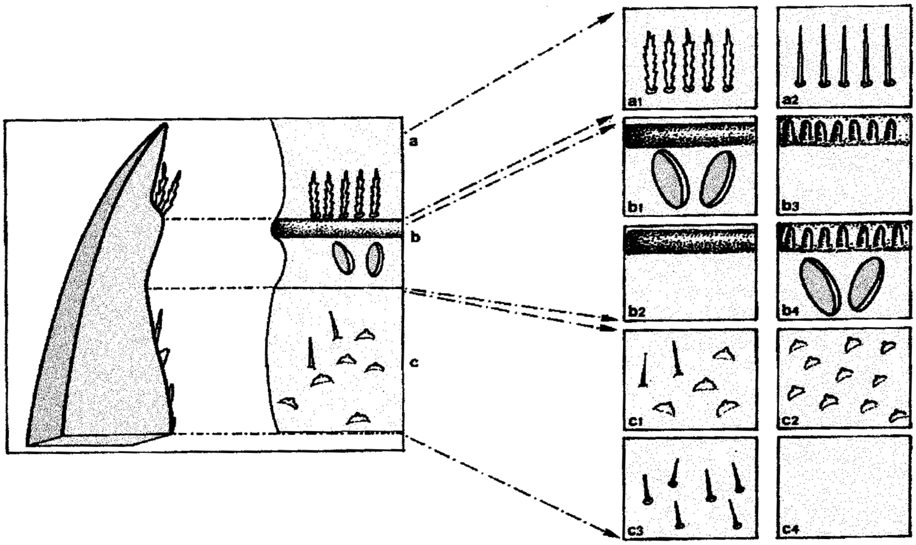


Fig. 12. Midbody endotergum: diagram showing the different combinations of characters carried by the structure.

Combinations of these characters seem to be highly specific and remain unchanged between the male and female, as well as between small and large conspecific specimens, and even between tergites (Fig. 13). Except for the median part of the tergite which often shows an intersegmental membrane densely covered with dark cones, the structure of the endotergum remains stable within a single tergite as well.

Legs:

Except for the second pair of legs, which bear the vulvae or the penes, the legs are very similar in both sexes. They are short and setose, and contain some important taxonomic characters like the coxal lobe or the tibial spine. The coxal lobe consists of a more or less rounded projection of the lateral border of the coxa (Fig.10), while the tibial spines are two dorsal spines borne by the apex of the tibia just at its junction with the tarsus (Fig. 11, arrow). In some rare cases like *S. rotundatum*, the legs show very small canals perforating the chitin and containing a small bristle (Fig. 11).

Pygidium:

Although the pygidium in the female remains very much the same within the genus, that in the male may be impressed, bearing a longitudinal, hairy stripe (Fig. 14) or a little knob at the posterior border, or the margin may be swollen like a bell (Fig. 15). The underside is always setose except, in the male, for two patches of regularly arranged granules (Fig. 18). These granules are the corresponding part of the main stridulatory organ borne by the posterior telopod (Fig. 21, arrow).

Vulva:

The morphology of the vulva is very constant within *Sphaerotherium*. It is composed of a basal bursa overtopped by an operculum. The bursa, divided into an internal and an external part, embraces the operculum at its medial and lateral edges. While the bursa is uniform, the shape of the operculum varies from rod-like to broadly rounded (Figs 16, 17).

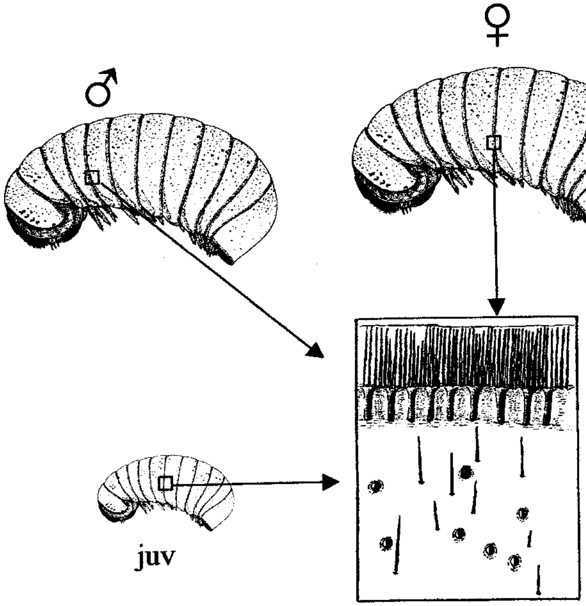


Fig. 13. Diagram illustrating the stability of endotergum between the sexes and stadia.

Penes:

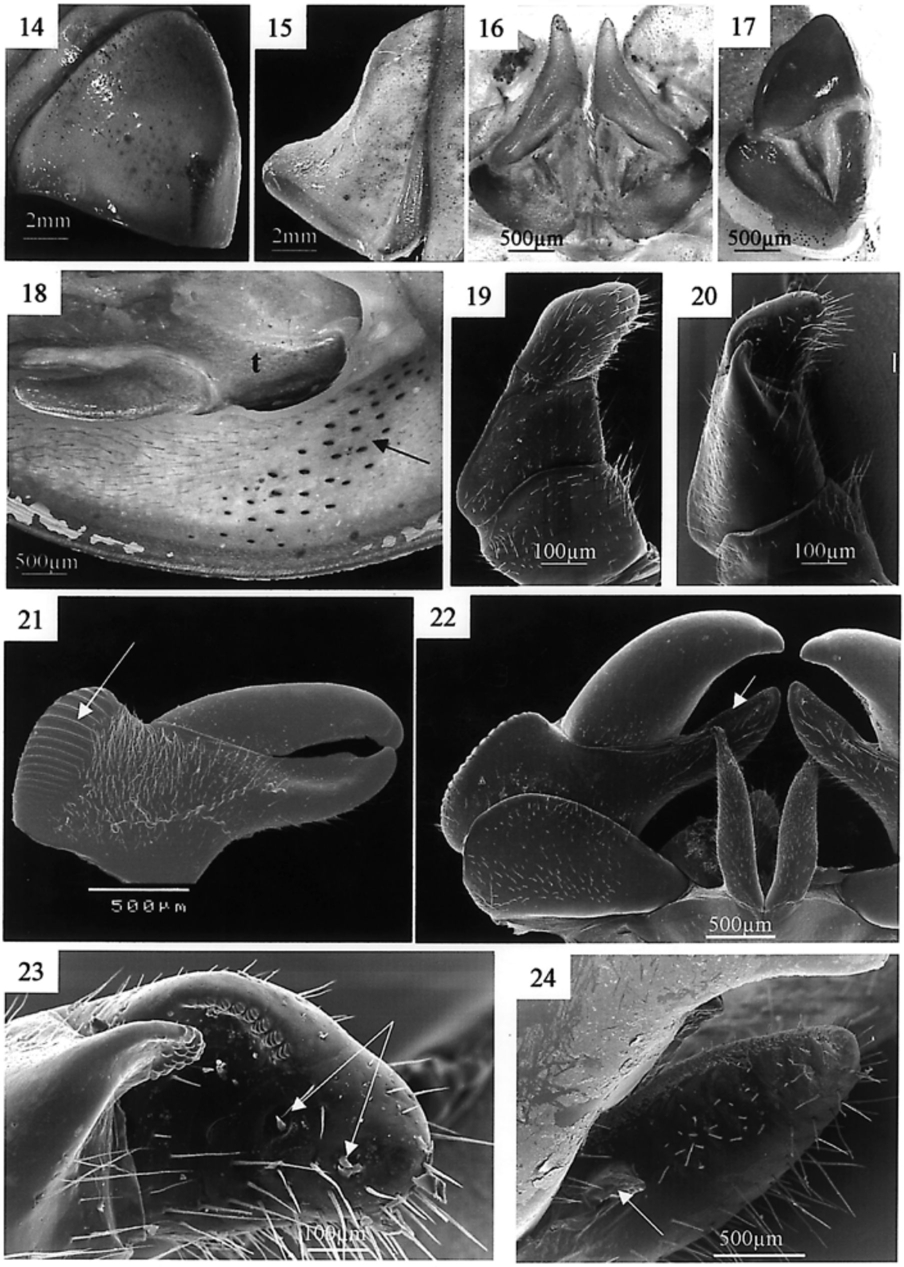
The penes in *Sphaerotherium* species are a small structure, poorly chitinised, which offer very little taxonomic information. Therefore they will not be illustrated here.

Telopods:

Two pairs of telopods occur in the caudal part of the male, i.e. the anterior and posterior telopods.

Anterior telopods consist of a syncoxite and two telopodites. Syncoxite is formed by the junction of two coxae and bears the telopodites. Each telopodite consists of 3–4 articles: femur, tibia, and 1 (or 2) tarsus (Figs 19, 20). Femur is nearly cylindrical, whereas tibia has a characteristic median process extending up to approximately the midway of tarsus; apex of this process always possesses some granules/papillae. The tarsus, broadening distad up to 1/3 its length, bears a series of sclerotised ridges facing the tibial granules; together they form a small stridulatory organ (Fig. 23). A small tactile spine is often present at the apex of the tarsus (Fig. 23, arrows).

Posterior telopods are more complex. They consist of a syncoxite, two coxal horns, two subanal lobes, and two telopodites (Fig. 22). The subanal lobes and horns provide no characters relevant to the taxonomy of the genus, because their size and shape vary considerably, even depending on the position of the preparation under the microscope. On the other hand, the telopodites are more specific; like the anterior telopodites, they consist of 3–4 articles: femur, tibia, and 1 (or 2) tarsus (Figs 21, 22). Although the femur shows no peculiarities, the tibia carries on its latero-aboral side a well-expressed cushion-shaped swelling covered with transverse ridges (Fig. 21, arrow). Together with the granules visible on the underside of the pygidium, these stridulatory ridges form the



Figs 14–24. Sexual characters in *Sphaerotherium*. 14. *S. trichopygum* ♂, posterolateral view of pygidium. 15. *S. retusum* ♂, lateral aspect of pygidium. 16–17. Cyphopods. 16. *S. elongatum*. 17. *S. intermedium.* 18. *S. trichopygum* ♂, main stridulatory organ (t: posterior telopodite, arrow: patch of granules on underside of pygidium). 19–20. Anterior telopod. 19. Anterior aspect. 20. Posterior aspect. 21. Posterior view of stridulatory organ of posterior telopod. 22. Anterior aspect of posterior telopod. 23. Structures in apical part of anterior telopod, posterior view. 24. Apical part of posterior telopod showing a finger-shaped process (arrow).

main stridulatory organ. Lateral edge of tibia has a prominent process forming a kind of pincer with the tarsus. Side of tibial process facing tarsus carries several structures like a finger-shaped process and/or some tactile bristles (Fig. 24). Tarsus and tibial process, crenulated along front margin, appear to form still another small stridulatory organ.

Distribution: *Sphaerotherium* species occur from Malawi to South Africa, and the genus is most diverse in the Western and Eastern Cape, and KwaZulu-Natal.

SPECIES DESCRIPTIONS AND NOTES

Sphaerotherium compressum Brandt, 1833

(Figs 25a–k, 34)

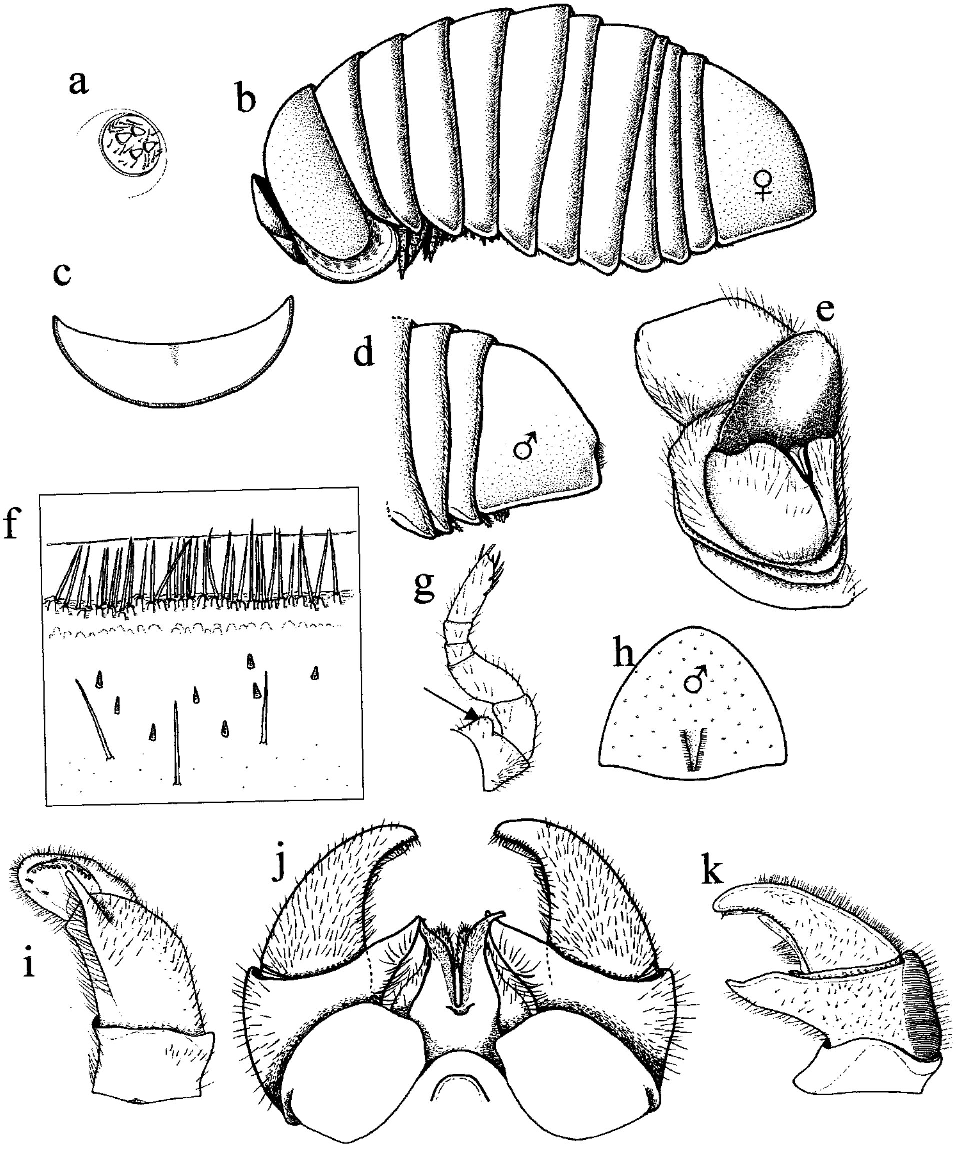
Sphaerotherium klugii *Brandt, 1841.* **Syn. n.**
Sphaerotherium repulsum *Karsch, 1881.* **Syn. n.**
Sphaerotherium trichopygum *Attems, 1908.* **Syn. n.**
Sphaerotherium ancillare Attems, 1928. **Syn. n.**

Material studied:

Type material: *S. compressum*: lectotype ♂ (without telopods, designated herewith), paralectotypes: 1♀, Promontorium Bonae Spei (Cape), Krebs leg.; ZMB 62; 1♀, incomplete, Caput Bonae Spei (Cape); ZISP.
S. klugii: ♀ lectotype, South Africa, Caput Bonae Spei (Cape); ZISP.
S. repulsum: ♀ holotype, South Africa, Caput Bonae Spei (Cape); ZMB 371.
S. trichopygum: ♂ lectotype (without telepods, designated herewith), paralectotypes: 1♂ (without telopods), 1♀, South Africa, Simonstown, Millers Point, Kapland, 23.vii.1903, Vanhöffen (German South Polar Expedition 1901–1903); ZMB 4672.
S. ancillare: ♀ lectotype (designated herewith), South Africa, Newlands, Cape Town, 03.viii.1900, W. F. Purcell; SAMC-ENW-X7693; 3 ♀ paralectotypes, South Africa, Table Mountain above Klaassenbosch, ix.1901, W. F. Purcell; SAMC-ENW-X150158.
Other material: Numerous *S ancillare* and *S. trichopygum* ♂ and ♀ from MRAC, SAMC and TMSA, various dates and collectors.

Description:

Total length ranging from 14–34, width from 8–17.
Colour light olive green to brown, tergites bordered with dark brown along posterior margins, underside and legs dark olive green.
Head with a few piliferous punctures growing denser towards clypeus; gnathochilarium densely pilose. Both sides of labrum broadly rounded laterad, middle scarcely emarginate, with a single median tooth. Ocelli obvious, almost black or dark olive green. Antennomere 8 with four apical sensory cones.
Collum smooth, with one row of setae along anterior margin, underside setose.
Thoracic shield with brim relatively narrow, accompanied by row of long setae along its margin, underside setose.
Tergites 2–12 with a slight but visible median keel, surface extremely finely punctate, and bearing minute hairs. Endotergum with one row of marginal bristles not projecting beyond margin, marginal ridge with a row of callosities but without cuticular pattern, intersegmental membrane with dark cones and long setae (Figs 25f, 34). Marginal bristles smooth.



Figs 25a–k: Paralectotypes of *Sphaerotherium compressum* (a–c, e–g) and *Sphaerotherium trichopygum* (d, h–j, k). a: apical part of antenna; b: lateral aspect of ♀ ; c: median keel of tergite 3; d: lateral aspect of posterior part of ♂; e: cyphopod; f: endotergum; g: leg 9 (arrow: coxal lobe); h: posterior aspect of pygidium in ♂; i: posterior view of anterior telopod; j: anterior aspect of posterior telopods; k: posterior aspect of apical part of telopod.

Legs with a well-developed lobe on outer side of coxae (Fig. 25g, arrow).
Male sexual characters:
Second pair of legs without coxal lobe.
Pygidium with low median wedge on slope, a characteristic band of short setae just beyond wedge (Figs 14, 25d, h), which is extremely variable from one specimen to another. This band may reach margin of pygidium or be reduced to a few setae just under the wedge, while in a few specimens setae lacking.
Anterior telopods with femur distinctly shorter than wide (Fig. 25i). Tibia with strong immovable conical process. Tarsus 1-segmented, distal outer surface beset with series of sclerotised ridges, apical anterior side bearing small tactile spines. Posterior telopods with long coxal horns surpassing bristly lobes, large at base and narrowing towards extremity, but with a widened tip (Fig. 25j). Femur large, outer surface broadly rounded. Lateral side of median femoral process without finger-like protuberance. Tarsus not segmented, a row of striated knobs on anterior side, concavity with two finger-like lobes (Fig. 25k).
Female sexual characters:
Neither wedge nor hairy band on pygidium, second legs without coxal lobe. Cyphopod large, covering more than two-thirds of caudal surface of coxae 2. Operculum almost rounded; a few setae mainly in apical and medial parts of vulvae (Figs 18, 25e).

Comments: Silvestri (1910) had already noted that *S. compressum* is close to *S. klugii*, and he even regarded *klugii* as a variety of *compressum*. We agree with this as a re-examination of type material using SEM confirms that they are conspecific. Therefore, *klugii* is a junior subjective synonym of *compressum*. The only male in the type series of *compressum* has been selected as lectotype, the other two specimens as paralectotypes.

Prior to this study, the species *repulsum* had never been re-examined and it was considered as a species *incertae sedis* by Schubart (1958) and Hamer (1998). Althought the holotype is a female, based on our examination there are sound reasons to regard *repulsum* as another synonym of *compressum*. In fact the endotergum and vulvae of the two species are very similar.

Attems (1928) suggested that *S. compressum* is identical to *S. trichopygum*, and although the male lectotype of *compressum* has no setae behind the wedge of the pygidium, we agree with Attems' (1928) opinion. In fact, examination of a large number of *trichopygum* samples revealed great variation in the sculpture of the pygidium. Some males have a band of setae forming a V-shaped structure running up to the margin of the pygidium, some have just a few setae, while in some other specimens the setae are lacking.

Closer study of *S. ancillare*, another species in which the male shows a band of setae in the posterior part of the pygidium, revealed it also to be a formal synonym of *compressum*, with *S. ancillare* being just a "setiferous form". One of the male syntypes of *trichopygum* is here designated as lectotype, the other two syntypes as paralectotypes. Similarly, one female syntype of *S. ancillare* is designated as lectotype, the other three syntypes as paralectotypes.

S. trichopygum Attems, 1908 is the type species of *Neobournellum* Attems, 1908, but this species, like *S. rotundatum*, shows four apical sensory cones on the antenna. So *Neobournellum* is confirmed as being a strict junior subjective synonym of *Sphaerotherium s. str.* (see also below under *S. rotundatum*).

Sphaerotherium dorsale (Gervais, 1847)

(Figs 26a–h, 35)

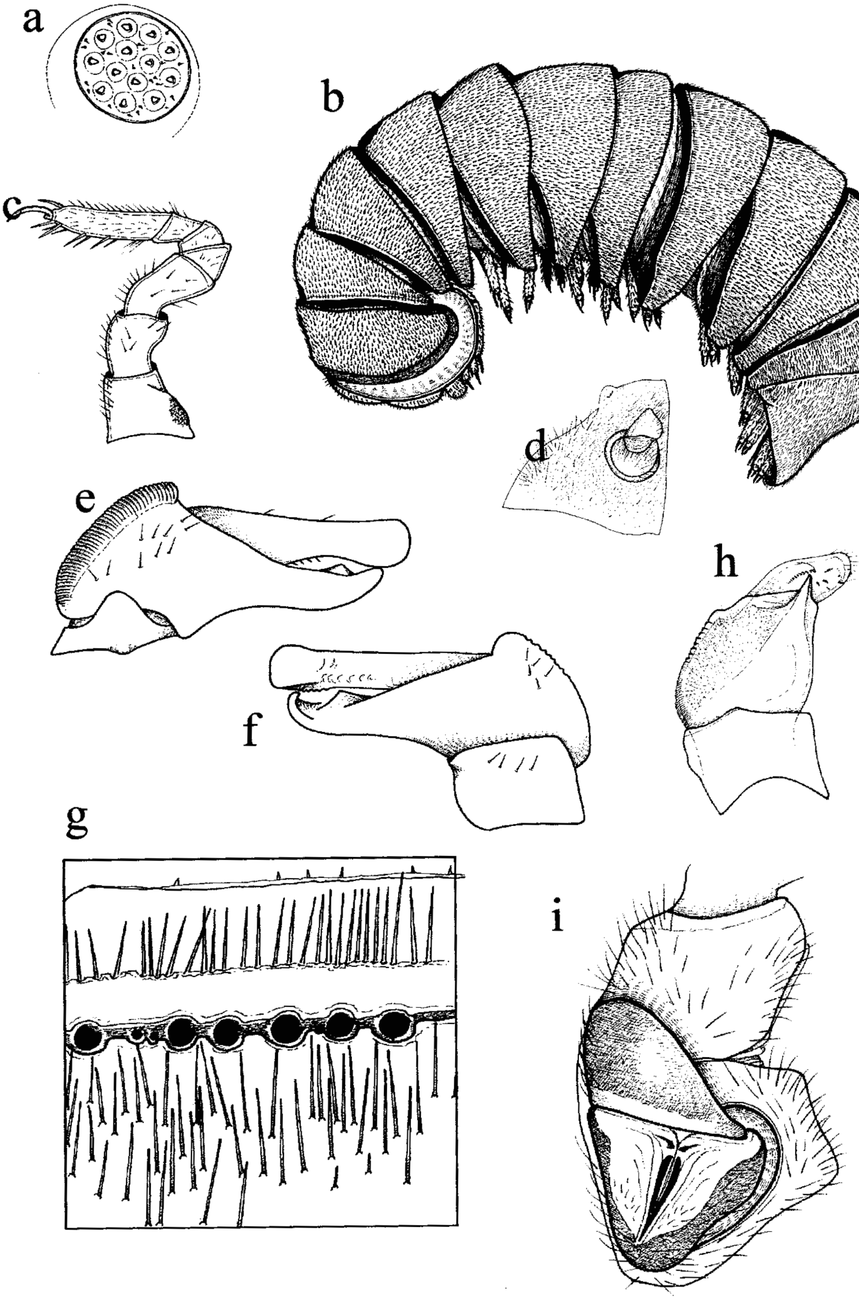
Sphaerotherium retusum C. L. Koch, 1847. Synonymy confirmed.

Material studied:
Type material: *S. dorsale*: ♀ holotype; provenance unknown; MHNP.
S. retusum: ♂ holotype; South Africa, Cape of Good Hope; ZMB 64.
Other material: 2♀, types (?), South Africa, Caffraria; 1840–1845; J. A. Wahlberg; SMNH.
Numerous ♂ and ♀ from MRAC, SAMC and TMSA, various dates and collectors.

Description:

Total length ranging from 10–35, width from 7–15, average length 25.
Colour: Head, antennae and collum dark olive green. Thoracic shield, tergites and pygidium castaneous, a little darker along posterior margin. Underside and legs dark olive green.
Head densely punctate-pilose, with hairs growing denser toward clypeus; gnathochilarium densely pilose, labrum with a single median tooth. Ocelli obvious, almost black. Antennae with numerous apical sensory cones (up to 38).
Collum densely punctate-pilose, with one row of long hairs along margin.
Thoracic shield setiferous; brim large, accompanied by a row of longer setae.
Tergites 2–12 with well-developed black keels, surface covered with very dense setiferous punctures providing the impression of a furry body (Fig. 26b). Endotergum with one row of scaled marginal bristles extending up to margin, marginal ridge with a row of very small callosities. A row of cuticular patterns forming a row of light spots behind ridge. Intersegmental membrane densely covered with long hairs, dark cones only visible in median part (Figs 26g, 35).
Legs without lateral lobe on coxa (Fig. 26c).
Male sexual characters:
Second pair of legs bearing pseudopenes, latter rather narrow and short (Fig. 26d); no coxal lobe.
Pygidium depressed in the middle, with an elevated margin (Fig. 14).
Anterior telopods with an incompletely divided or undivided tarsus, distal outer surface of anterior part beset with a series of sclerotised ridges, apical anterior bearing a small wart and a small tactile spine (Fig. 26i). Posterior telopods with pincers relatively flat, less strongly arched than in other species. Lateral side of median tibial process with one triangular protuberance. Tarsus 1-segmented, a row of striated knobs on anterior side, concavity with some spines on a low protuberance and a slightly enlarged apical part (Fig. 26e, f).
Female sexual characters:
Second pair of legs without coxal lobe. Cyphopod with a rounded operculum.

Comments: Attems (1928) considered *S. retusum* as a synonym of S. *dorsale*. Although his opinion was obviously not justified by a restudy of pertinent type material, we agree as the holotypes of the two species share the same body and posterior telopod structure, which alone is sufficient for safely determining the species.



Figs 26a–i. Holotypes of *Sphaerotherium retusum* (a–h) and *Sphaerotherium dorsale* (i). a: apical part of antenna; b: lateral aspect of ♂; c: leg 9; d: penes; e: posterior view of apical part of telopod; f: anterior aspect of apical part of telopod; g: endotergum; h: posterior view of anterior telopod; i: cyphopod.

The synonymy of *Zephronia puverea* with *Sphaerotherium dorsale* proposed by Schubart (1958) requires verification as this was not explained by him and was apparently not based on a restudy of pertinent types.

As the paper by Gervais (1847) appears to have been published a few months earlier than C. L. Koch's (1847) (cf. Jeekel, 1970), the name *S. dorsale* has priority over *S. retusum*.

As *Sphaerotherium retusum* C. L. Koch, 1847 is the type species of both *Bournellum* De Saussure & Zehntner, 1902, and *Eubournellum* Attems, 1908, the latter name is a junior objective synonym to be suppressed (Jeekel 1970). *Bournellum* is currently the earliest available genus-group name to encompass the congeners with seven or more sensory cones on the ultimate antennomere (see also below under *S. rotundatum*). However, this character is so weak that we cannot uphold this subgeneric division of *Sphaerotherium*. There is one large sample of a *Sphaerotherium* species from KwaZulu-Natal (NMSA) containing a single specimen with six cones on antennomere 8, meaning that any classification based on this character alone cannot be used.

Sphaerotherium elongatum Brandt, 1833

(Figs 27a–g, 36)

Sphaerotherium microstictum Brandt, 1841. **Syn. n.**

Material studied:

Type material: *S. elongatum:* 1♀ paralectotype; loc. ?; ZMB 59; M lectotype (designated herewith), 2♀ paralectotypes, South Africa, Promontorium Bonae Spei (Cape), Krebs leg.; ZMB 60; 1♀ paralectotype, South Africa, Caput Bonae Spei; ZISP.

S. microstictum: M (lectotype, designated herewith), 4♀, 2 juv. paralectotypes, South Africa, Caput Bonae Spei (Cape); ZISP.

Other material: 5♂3♀, South Africa, Port Elizabeth; NHML.

Description:

Total length ranging from 14–33, width from 7–18.

Colour: Head, antennae and collum orange brown. Thoracic shield, tergites and pygidium from orange brown to olive green bordered with brown along posterior margin. Underside and legs dark orange brown.

Head with e few piliferous punctures growing denser towards clypeus; gnathochilarium densely pilose. Both sides of labrum broadly rounded laterad, with a single median tooth. Ocelli black. Antennomere 8 with 4–5 apical sensory cones.

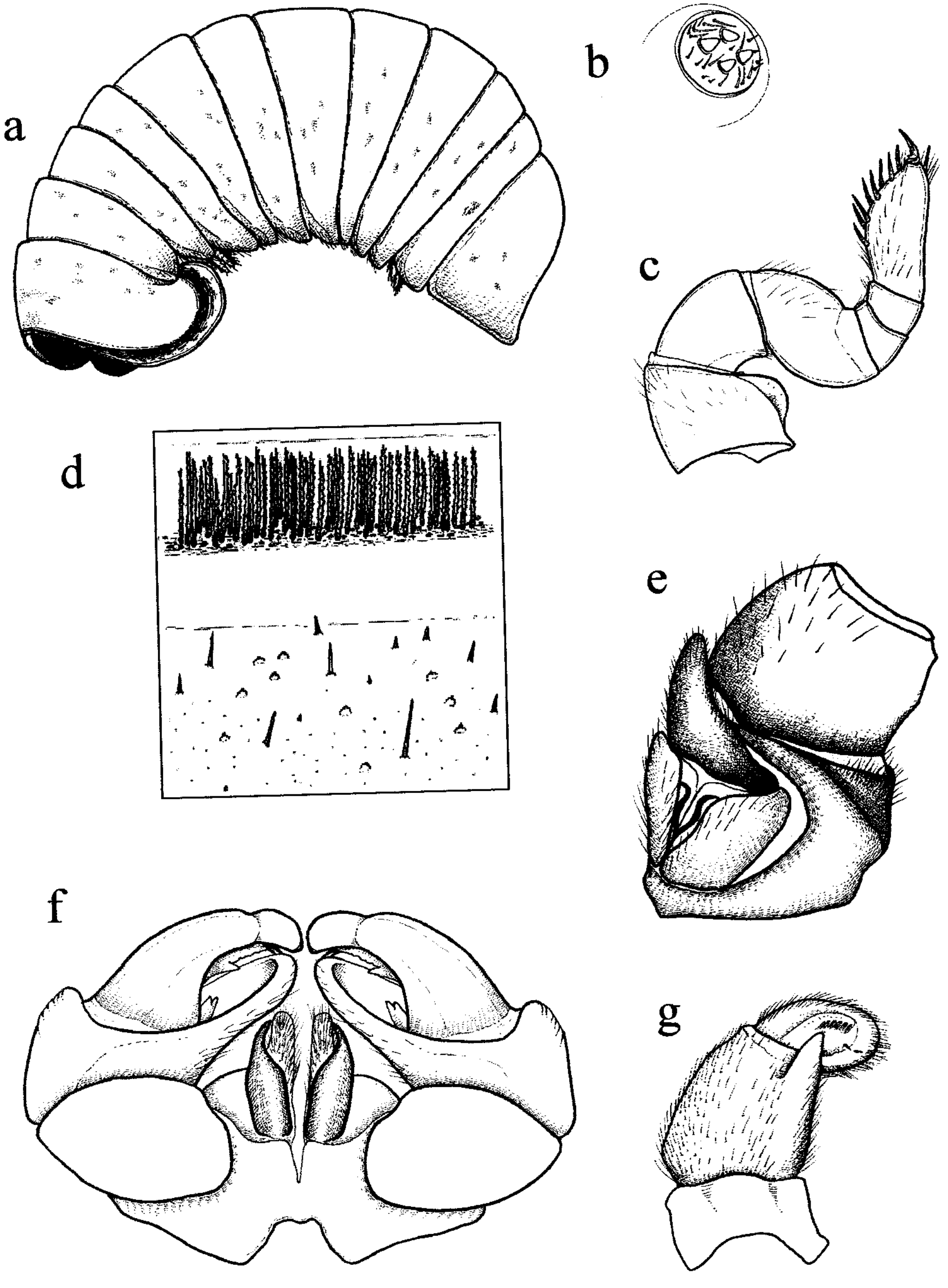
Collum generally smooth, with one row of setae along anterior margin.

Thoracic shield with brim relatively narrow, accompanied by a row of long setae.

Tergites devoid of a median keel, surface covered with very dense, minute, piliferous punctures. Endotergum with pinnate marginal bristles arranged in several (up to 5) rows and extending up to margin, marginal ridge with neither row of callosities nor a cuticular pattern, intersegmental membrane with cones and a few long setae (Figs 27d, 36).

Pygidium: Surface without any peculiarities, margin slightly elevated.

Legs without coxal lobe (Fig. 27c).



Figs 27a–g. *Sphaerotherium elongatum* (a–e, ♀ paralectotype and f–g, ♂ lectotype). a: lateral aspect; b: apical part of antenna; c: leg 9; d: endotergum; e: cyphopod; f: anterior view of posterior telopods; g: posterior aspect of anterior telopod.

Male sexual characters:
Second pair of legs without coxal lobe.
Anterior telopods with femur distinctly shorter than wide. Tibia with a strong, immovable, conical process. Tarsus 1-segmented, distal outer surface beset with a series of sclerotised ridges, apical side of segment with two tactile spines (Fig. 27g). Posterior telopods with long coxal horns surpassing bristly lobes, large at base and narrowing towards extremity, but with a broadened tip. Femur large, outer surface broadly rounded. Lateral side of tibial process with two finger-shaped protuberances.
Tarsus 2-segmented, a row of striated knobs on anterior side of first segment. Concavity with one digitiform lobe on first segment, some tactile spines on second segment (Fig. 27f).
Female sexual characters:
Cyphopod large, operculum rod-shaped with a rounded tip. A few setae mainly in apical and medial parts of vulvae (Fig. 27e).

Comments: *S. microstictum* is considered here as a junior subjective synonym of *S. elongatum.* This taxonomic decision is based on the structure of the marginal bristles, which are pinnate and arranged in several rows, a diagnostic character restricted to *S. elongatum*. According to our observations, *S. granulatum,* which is from the same locality as *S. elongatum,* may also be a junior synonym of this species. At present, however, both are kept separate based on the structure of the male pygidium, which is smooth in *elongatum*, but seems to be granulated in *granulatum.* This difference is perhaps infraspecific variation, but since the type of *Sphaerotherium granulatum* Pocock, 1895 has not been revised, no formal taxonomic decision can be made.

The single male in each of the type series has been selected as lectotype, the other syntypes as paralectotypes.

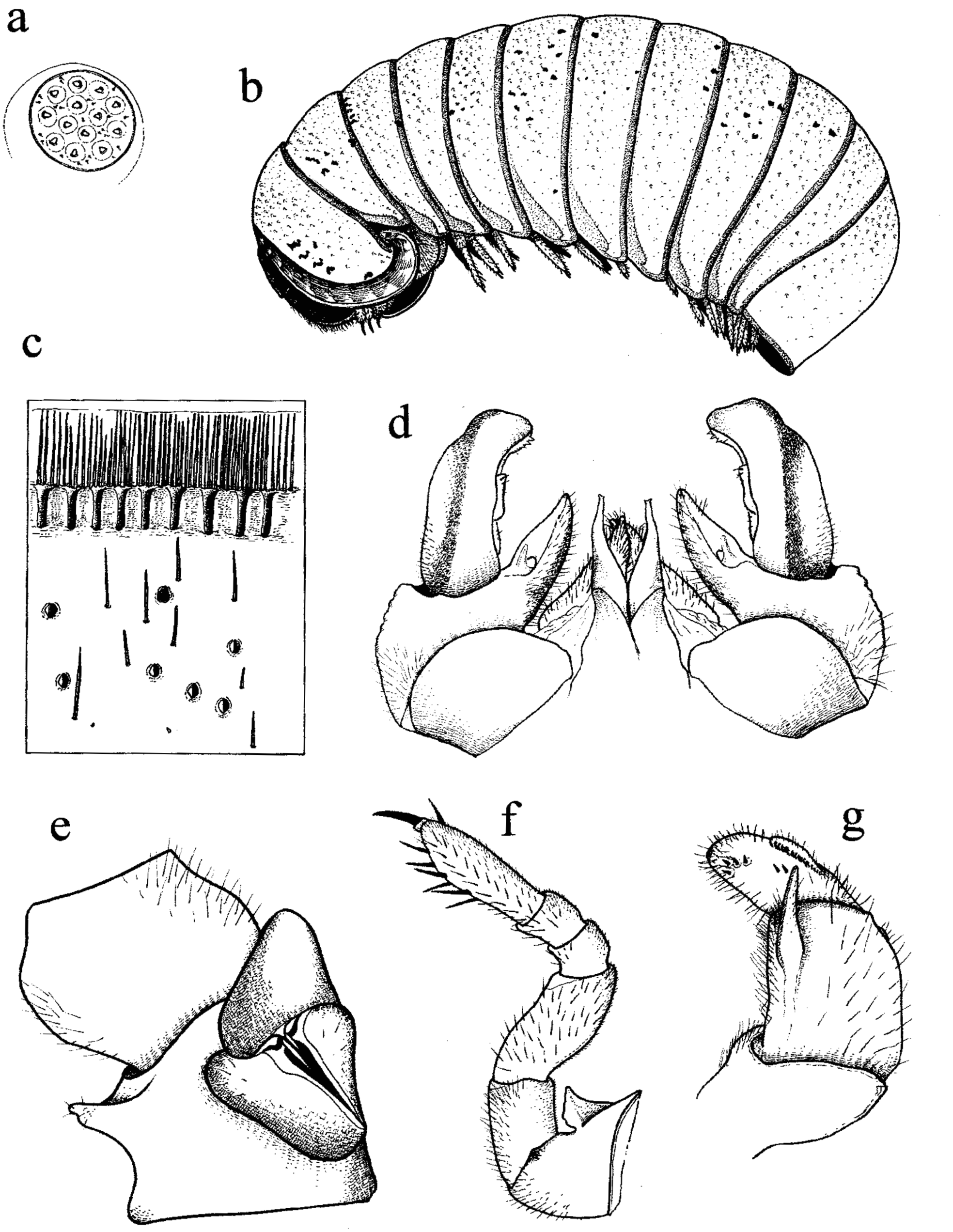
Sphaerotherium giganteum Porat, 1872

(Figs 28a–g, 37)

Material examined:
Type material: :♀ lectotype (designated herewith), ♀ paralectotype, South Africa, Caffraria, 1845, J. A. Wahlberg; SMNH.
Other material: numerous ♂ and ♀ from MRAC, SAMC and TMSA, various dates and collectors.

Description:

Total length ranging from 10–55, width from 7–20, average length 30.
Colour: Head, antennae and collum orange brown. Thoracic shield, tergites and pygidium yellow brown, bordered with dark brown along posterior margin. Underside and legs dark orange brown.
Head with a few piliferous punctures growing denser towards clypeus and apical part of head; gnathochilarium densely pilose. Both sides of labrum broadly rounded laterad, middle scarcely emarginate, with a single median tooth. Ocelli obvious, almost black.
Antennae short, antennomere 8 with 7–17 apical sensory cones.
Collum smooth, pilosity growing longer along anterior margin.



Figs 28a–g. *Sphaerotherium giganteum* (a–c, e, f, ♀ lectotype). a: apical part of antenna; b: lateral aspect of ♀ ; c: endotergum, median keel of tergite 3; d: anterior aspect of posterior telopods; e: cyphopod; f: leg 9; g: posterior view of anterior telopod.

Thoracic shield with brim relatively narrow, accompanied by a row of longer setae along its margin, surface covered with fine piliferous punctation. Underside covered with long setae.

Tergites without median keel, surface like that of thoracic shield. Endotergum with one row of marginal hairs surpassing margin, marginal ridge with one row of well-developed callosities, no cuticular pattern, intersegmental membrane covered with long setae and different dark cones (Figs 28c, 37).

Legs with a well developed lateral lobe on coxa (Fig. 28f).

Male sexual characters:

Second pair of legs with coxal lobe.

Pygidium of largest specimens with a small spot of very short setae in posterior, premarginal part.

Anterior telopods with an undivided tarsus, distal outer surface beset with series of sclerotised ridges, apical anterior side bearing several small tactile spines (Fig. 28g).

Posterior telopod with large femur. Lateral side of median tibial process with one finger-like protuberance. Tarsus 1-segmented, a row of striated knobs on anterior side, concavity with a broad triangular lobe with several spines and a small apical protuberance with several spines (Fig. 28d).

Female sexual characters:

Second pair of legs with a coxal lobe. Cyphopod large, with a more or less triangular operculum. Vulvae setose (Fig. 28e).

Comments: This species is widespread in South Africa, and is also the largest member of the genus. The best preserved syntype has been selected as lectotype, the remaining female as paralectotype.

Sphaerotherium intermedium Porat, 1872
(Figs 29a–f, 38)

Material examined:

Type material: ♀ holotype, South Africa, Caput Bonae Spei, 1854, [det.] von Porat; SMNH.

Description:

Total length 34, width 17.

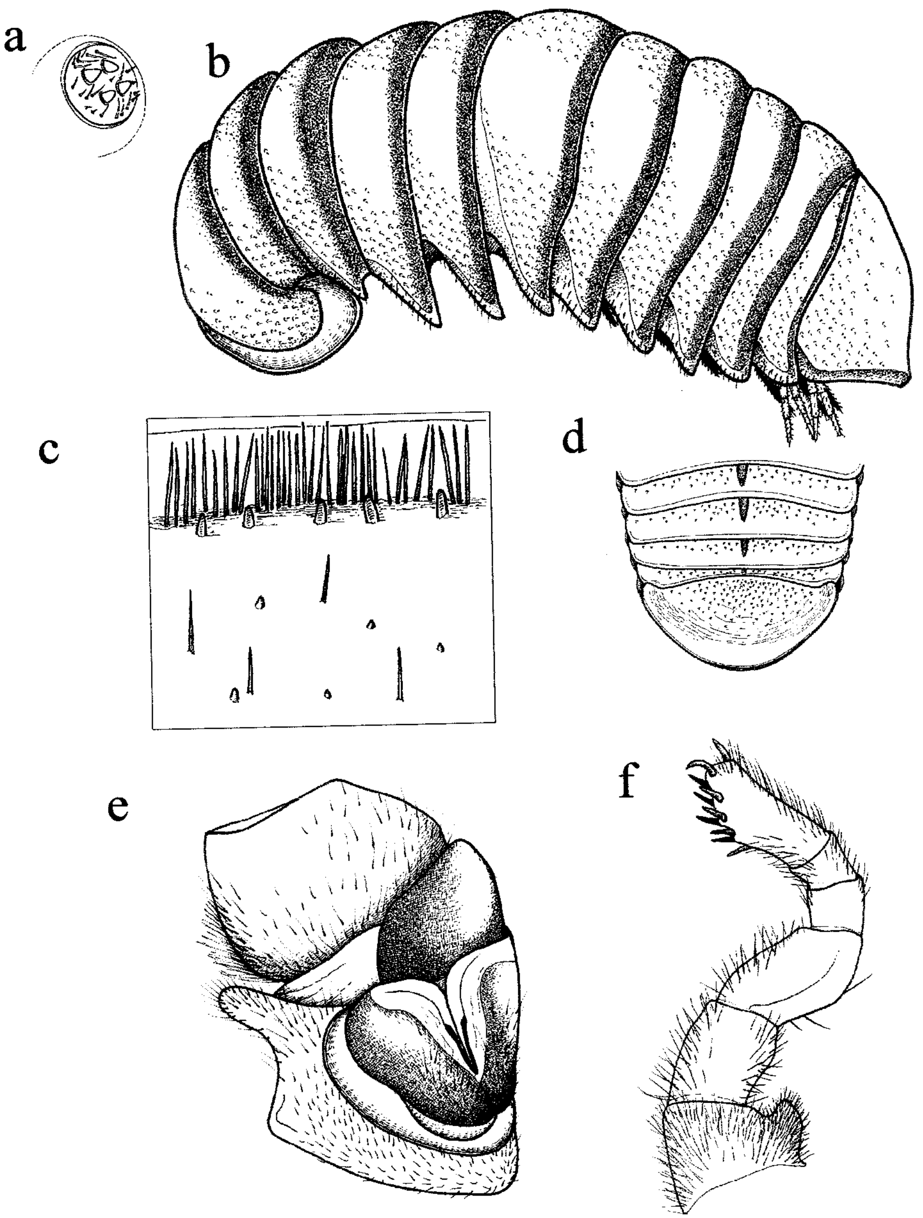
Colour: Head, antennae and collum dark brown. Thoracic shield, tergites and pygidium from light brown to olive green bordered with dark brown along posterior margin. Underside and legs dark olive green.

Head with a few piliferous punctures growing denser towards clypeus; gnathochilarium densely pilose. Both sides of labrum broadly rounded laterad, with a single median tooth. Ocelli black. Antennae short, last segment with four apical sensory cones.

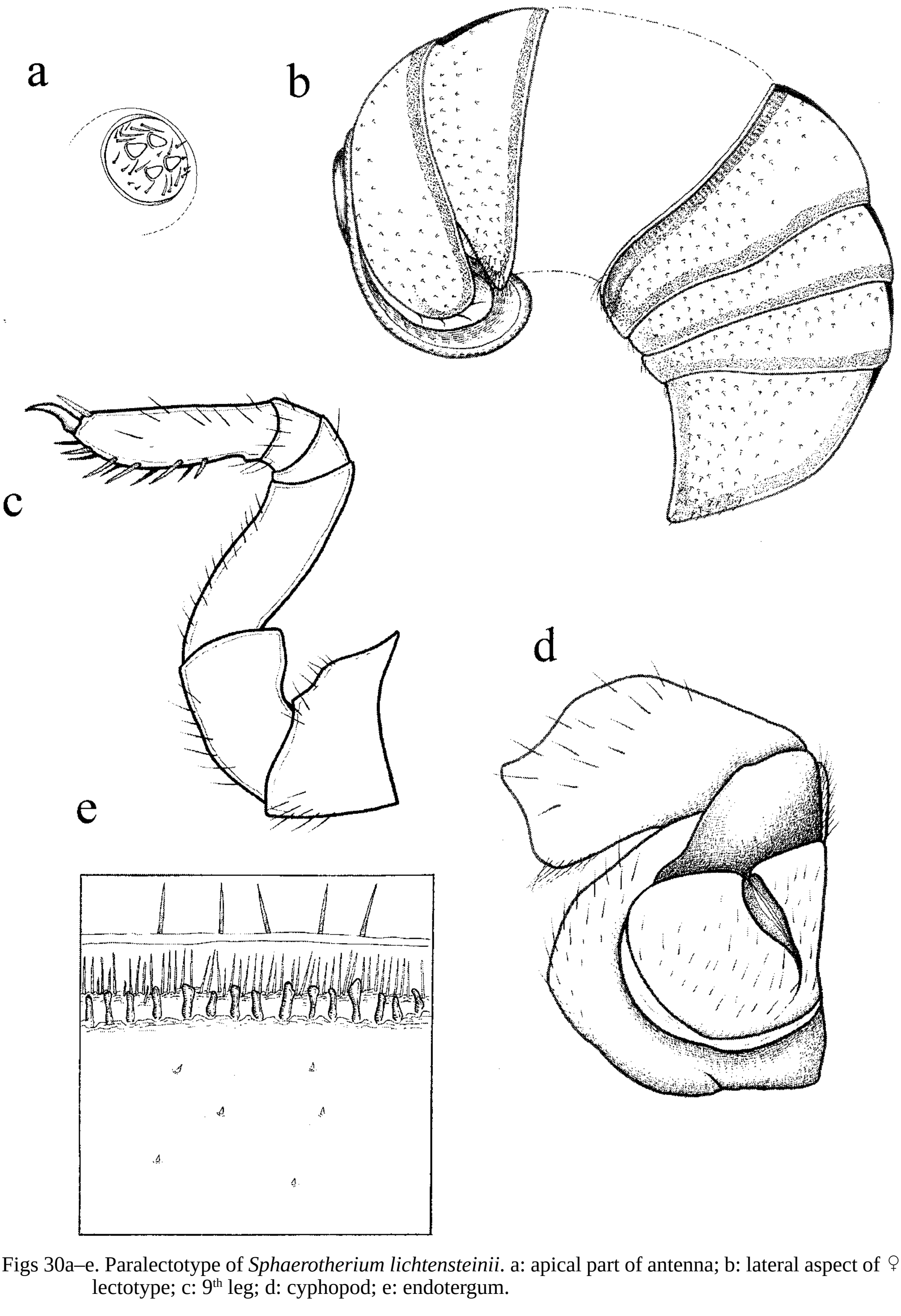
Collum slightly punctate-pilose.

Thoracic shield with brim relatively narrow, accompanied by row of long setae.

Tergites with median keel, surface densely punctate-piliferous. Endotergum with long marginal bristles arranged in one row, bristles reaching margin; marginal ridge with row of callosities intruding zone of bristles. No cuticular pattern, intersegmental



Figs 29a–f. Holotype of *Sphaerotherium intermedium*. a: apical part of antenna; b: lateral aspect; c: endotergum; d: median keel of posterior tergites; e: cyphopod; f: 9th leg.



Figs 30a–e. Paralectotype of *Sphaerotherium lichtensteinii*. a: apical part of antenna; b: lateral aspect of ♀ lectotype; c: 9th leg; d: cyphopod; e: endotergum.

membrane with a few cones and a few quite long setae (Figs 29c, 38).
Pygidium: Surface without any peculiarities, margin elevated.
Legs with a well marked lateral lobe on coxa (Fig. 29f).
Female sexual characters*:*
Second pair of legs with coxal lobe. Cyphopod large, operculum slightly triangular with setae mainly in medial part of vulvae (Fig. 29e).
Male:
Unknown.

Comments: Prior to this study, *S. intermedium* had only been revised by Silvestri (1910), and at present the species seems only to be known from the female holotype kept in the Stockholm Museum.

Sphaerotherium lichtensteinii Brandt, 1833
(Figs 30a–e, 39)

Material studied:
Type material: ♀ paralectotype, South Africa, Promontorium Bonae Spei (Cape), Lichtenstein leg.; ZMB 63;♀ lectotype (designated herewith), South Africa, Caput Bonae Spei (Cape); ZISP.

Description:

Colour: Head, collum, thoracic shield, tergites and pygidium olive green bordered with dark olive green along posterior margin. Underside and legs dark olive green.
Head with large piliferous punctures growing denser towards clypeus; gnathochilarium covered with hairs. Both sides of labrum broadly rounded laterad, middle scarcely emarginate, with a single median tooth. Ocelli obvious, almost dark olive green. Antennae short, last segment with four apical sensory cones.
Collum smooth, bordered by one row of setae along margin.
Thoracic shield with brim large, accompanied by a row of long setae.
Tergites 2–12 with well-developed keel, surface covered with very dense and fine piliferous punctures, pilosity growing longer along posterior margin. Endotergum with one row of marginal hairs not reaching margin; marginal ridge with row of well-developed callosities intruding zone of bristles, no cuticular pattern, intersegmental membrane with small dark cones and very sparse setae (Figs 30e, 39).
Legs without coxal lobe, tibia not spined above (Fig. 30c).
Male:
Unknown.
Female sexual characters:
Second pairs of legs without coxal lobe. Cyphopod large, covering more than two-thirds of caudal surface of coxa 2. Operculum more or less rounded (Fig. 30d).

Comments: Since the original description, this species has been referred to by many authors as *incertae sedis*. It seems to only be known from two type specimens, with the female kept in ZISP chosen as the lectotype, the one in ZMB as paralectotype. Even though no male material is still available, *lichtensteinii* is undoubtedly a valid species.

Following Jeekel (2001), we also consider the records of *S. lichtensteinii* in Borneo and Java by Tömösvary (1885) and Daday (1889), respectively, as erroneous.

Sphaerotherium obtusum C. L. Koch, 1847

Figs 31a–i, 40

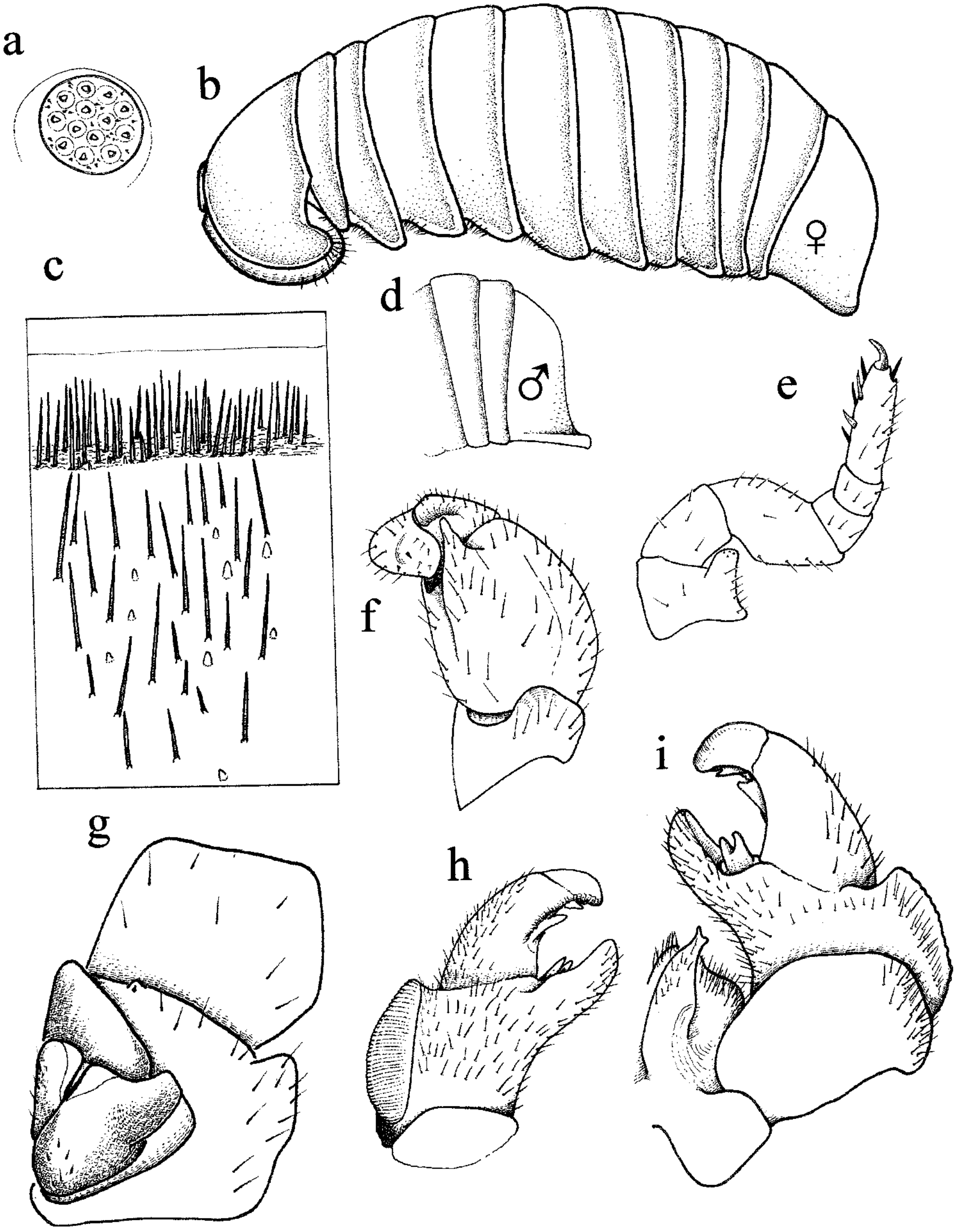
Sphaerotherium grossum C. L. Koch, 1847. **Syn. n.**

Material studied:
Type material: *S. obtusum*: ♀ holotype, South Africa, Caput Bonae Spei (Cape); ZMB 58.
S. grossum: ♀ holotype, South Africa, Caput Bonae Spei (Cape); ZMB 57.
Other material: *S. obtusum*: 2♂, South Africa, Port Elizabeth, A. E. Craven; NMHL.

Description:

Total length *ca* 30, width *ca* 22.
Colour: Head, antennae and collum brown. Thoracic shield, tergites and pygidium light olive green to brown with numerous white punctures and bordered with dark brown along posterior margin. Underside and legs olive green.
Head with piliferous punctures growing denser towards clypeus; gnathochilarium densely pilose. Both sides of labrum broadly rounded laterad, middle scarcely emarginate, with a single median tooth. Ocelli obvious, almost black. Antennae short, last segment with 13–17 apical sensory cones.
Collum slightly punctate, with one row of setae along margin.
Thoracic shield smooth, brim relatively narrow, accompanied by a row of long setae; underside pilose.
Tergites without median keel, surface covered with white punctation and extremely short setae, mainly so in anterior one-third of tergite, posterior one-third smooth. Endotergum with about two rows of scaly marginal hairs not reaching margin; marginal ridge with neither a row of callosities nor a cuticular pattern, intersegmental membrane densely covered with long setae and cones (Figs 31c, 40).
Legs with a well-developed lobe on coxa (Fig. 31e).
Male sexual characters:
Second pair of legs with a coxal lobe.
Anterior telopods with tarsus 2-segmented, distal outer surface beset with a series of well-developed sclerotised ridges, apical side of segment with two tactile spines (Fig. 31f). Posterior telopods with coxal horns slightly surpassing bristly lobes. Femur large, outer surface with strongly chitinised stridulatory organ. Lateral side of tibial process with two digitiform protuberances. Tarsus 2-segmented, a row of striated knobs on anterior side of both segments. Concavity with one finger-like lobe on first segment and one on second segment (Fig. 31g, h).
Female sexual characters:
Second pairs of legs with a coxal lobe. Cyphopod with an almost triangular operculum (Fig. 31i).

Comments: The only difference between the types of *grossum* and of *obtusum* concerns the colour of the tergites, brown in *grossum* but light olive green in



Figs 31a–i. *Sphaerotherium obtusum* (a–c, e, g, ♀ holotype). a: apical part of antenna; b: lateral aspect; c: endotergum; d: lateral aspect of posterior part of ♂; e: leg 9; f: posterior aspect of anterior telopod; g: cyphopod; h: posterior view of apical part of telopod; i: anterior aspect of posterior telopod.

obtusum, with the sole result being that the white punctation is less readily discernible in *obtusum*.

Although both *obtusum* and *grossum* have been described on the same page (Koch 1847: 98), the former name has been chosen as the valid one since it was proposed before the latter name.

De Saussure & Zehntner (1902) credited Bourne (1885) with the authorship of both *obtusum* and *retusum*, but, as pointed out by Jeekel (1970: 23), there is no evidence that either De Saussure & Zehntner or Bourne considered the material distinct from the earlier, valid homonyms described by C. L. Koch (1847 1863).

Sphaerotherium punctatum Brandt, 1833

(Figs 32a–e, 41)

Material studied:

Type material: ♀ lectotype (designated herewith), ♀ paralectotype (badly preserved), South Africa, Caput Bonae Spei, ZMB 56 & ZMB 497, respectively.

Description:

Total length 30, width 22.

Colour: Head, antennae, collum, thoracic shield, tergites and pygidium light olive green, bordered with brown along posterior margin. Underside and legs light brown to olive green.

Head with a few piliferous punctures; gnathochilarium densely pilose. Both sides of labrum broadly rounded laterad, middle scarcely emarginate, with a single median tooth. Ocelli obvious, almost black. Antennae short, last segment with 4 apical sensory cones.

Collum with piliferous punctures and one row of longer hairs along anterior margin.

Thoracic shield with brim relatively narrow, accompanied by row of long setae along its margin. Surface covered with piliferous punctures.

Tergites 2–12 with a median keel, surface densely pilose-punctate. Endotergum with one row of marginal bristles not reaching margin; marginal ridge with a row of callosities, intersegmental membrane with a few setae and small to large cones (Figs 32e, 41).

Legs without lateral coxal lobe (Fig. 32d).

Male:

Unknown.

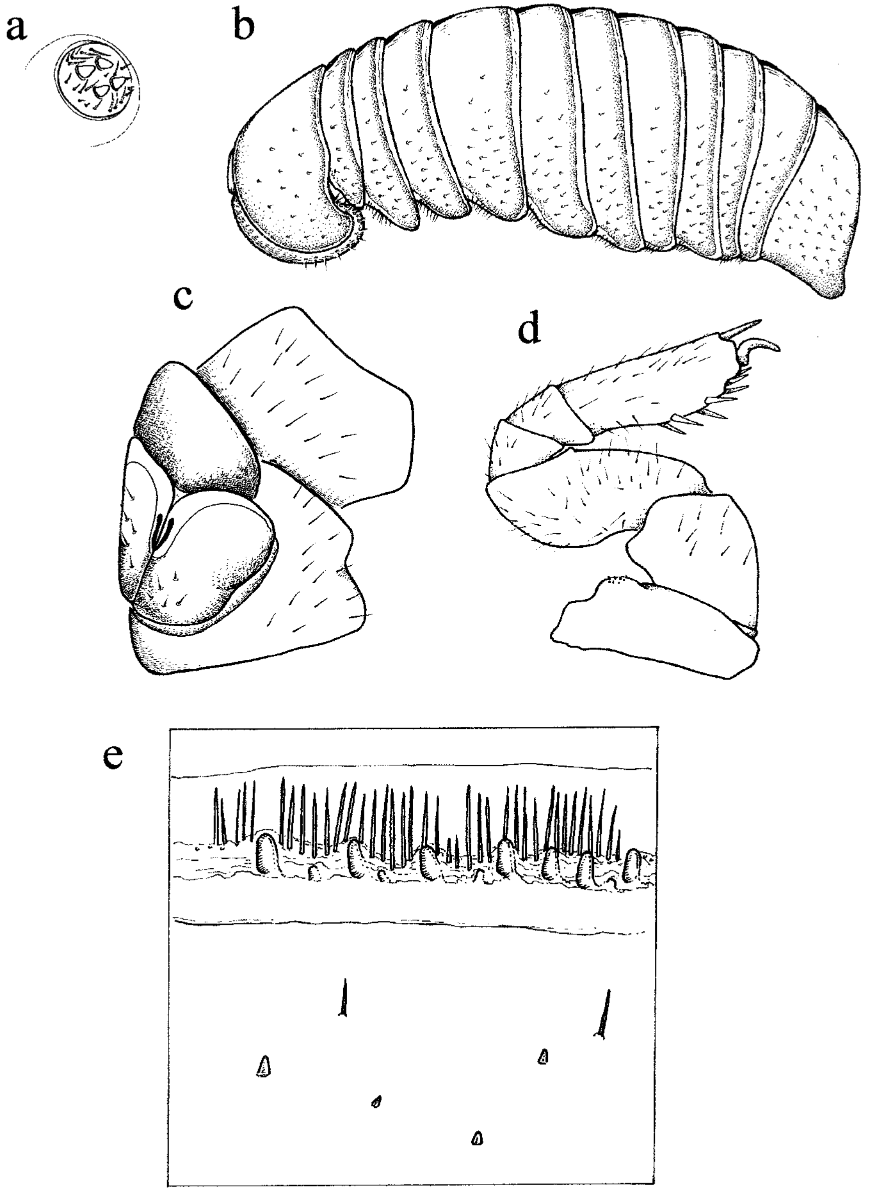
Female sexual characters:

Second pair of legs without coxal lobe. Cyphopod large, operculum almost rounded (Fig. 32c).

Comments: Prior to this study the type material seems never to have been revised. The species is only known from the above two female types housed in ZMB, with the male still unknown. Although the species was listed as *incertae sedis* by Attems (1928), Schubart (1958) and Hamer (1998), it must be considered as valid, while a complete revision of the genus is likely to reveal some junior synonym(s) among South African congeners.

Sphaerotherium punctulatum Brandt, 1841

See Van den Spiegel (2002) for a redescription of the species.



Figs 32a–e. Lectotype of *Sphaerotherium punctatum*. a: apical part of antenna; b: lateral aspect of ♀ ; c: cyphopod; d: leg 9; e: endotergum.

Comments: Among the unidentified material housed in NHML, the first author has traced some *Sphaerotherium* samples taken in Malawi. A careful examination revealed that they belong to *S. punctulatum*, most probably imported from South Africa through human agency. This provided an opportunity to redescribe *S. punctulatum*. Based on a re-examination of the type material kept in ZISP, the endotergum in the female paralectotype appears to be different from that of the male lectotype. In the succinct original description of *S. punctulatum* given by Brandt (1841*a*), no mention was made of the structure of the tergal underside, while Attems (1928) was apparently the first to illustrate this character. However, he must have depicted this structure using material more similar to the female paralectotype which, according to our observations, seems to be closer to *S. obtusum* than to *S. punctulatum*. The similarity between the two species was also observed by Butler (1873), who wrote in his succinct redescription of *punctulatum* that this species is identical to *obtusum*. Indeed, these species are very close and have very similar telopods. Yet both differ dramatically in the structure of the tergal underside (Figs 40, 42).

S. punctulatum is the type species of *Natalobelum* Verhoeff, 1924, but as both *S. punctulatum* and *S. retusum* C. L. Koch, 1947 share the increased number of apical sensory cones on the antenna, *Natalobelum* is a strict junior subjective synonym of *Bournellum* (see also above under *S. dorsale* and below under *S. rotundatum*).

Sphaerotherium rotundatum Brandt, 1833
(Figs 6, 7, 33a–h)

Oligaspis puncticeps Wood, 1865. **Syn. n.**
Sphaerotherium viride Porat, 1872. Synonymy confirmed.
Sphaerotherium pubescens Porat, 1872. Synonymy confirmed.

Material studied:
Type material: *S. rotundatum*: ♀ holotype, Caput Bonae Spei (Cape), Krebs leg.; ZMB 61.
S. viride: ♀ holotype, Caput Bonae Spei (Cape), 1854, [det.] von Porat; SMNH.
S. pubescens: ♂ holotype (without telopods), South Africa, Caffraria 1840–45, J. A. Wahlberg; SMNH.
Oligaspis puncticeps: ♂ neotype (selected herewith), RSA, KwaZulu-Natal, Umhlali, environs of Durban, October 1960, R. F. Lawrence; NMSA.
Other material: Numerous ♂ and ♀ from MRAC, SAMC and TMSA, various dates and collectors.

Description:

Total length ranging from 7–25, width from 4–12, average length 16.
Colour: Head, antennae and collum orange brown to olive green. Thoracic shield, tergites and pygidium light brown to olive green bordered with brown along posterior margin. Underside and legs olive green to light brown.
Head with a few hairs growing longer towards clypeus; gnathochilarium pilose. Both sides of labrum broadly rounded laterad, middle scarcely emarginate, with a single median tooth. Ocelli obvious, almost black. Antennae short, last segment with four apical sensory cones.

Collum smooth, bordered with one row of long setae.

Thoracic shield smooth, brim relatively large, accompanied by a row of long setae.

Tergites without median keel, surface smooth, with neither punctures nor setae. Anterior margin with hairs growing longer laterally. Endotergum highly characteristic, comprising one row of pinnate marginal bristles not reaching tergal edge, a marginal ridge without callosities but underlined by a row of circular impressions, and an intersegmental membrane with dark cones and long setae (Figs 6, 7, 33e).

Pygidium smooth, without peculiarities in both sexes.

Legs highly characteristic, without lobes on coxae but apical part of tibia showing two strong spines above (Fig. 11). Coxa, femur and tibia more or less fully covered with sensory organs consisting of an intraintegumental round cavity opening by a small aperture supporting a short sensitive hair (Figs 11, 33c).

Male sexual characters:

Second pair of legs without coxal lobe.

Anterior telopods with a 2-segmented tarsus (Fig. 33f). Posterior telopods relatively slender, lateral side of tibial process with one digitiform protuberance, tarsus incompletely or indistinctly divided in its apical part, with a row of striated knobs on anterior side and a concavity with two lobes supporting small tactile spines (Fig. 33f, g).

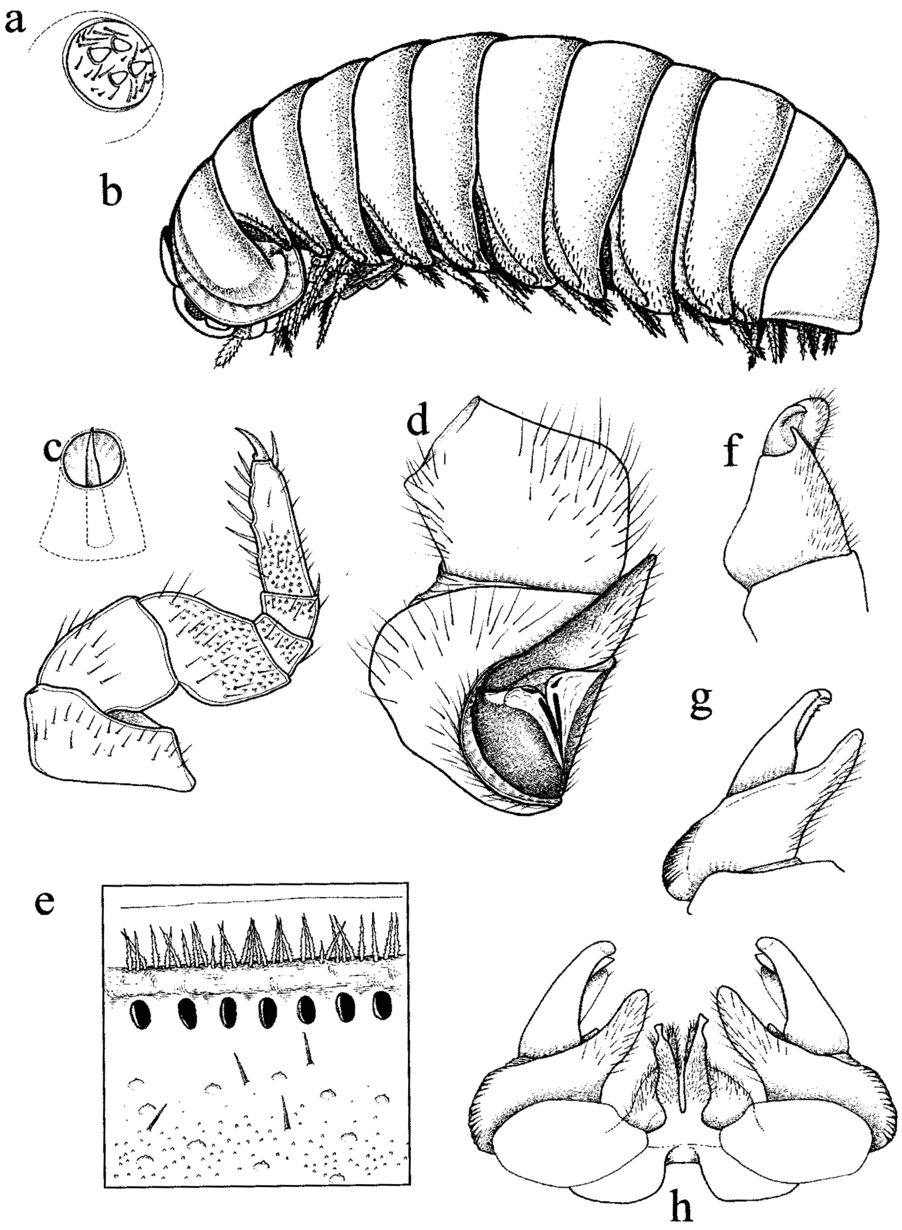
Female sexual characters:

No coxal lobe. Vulvae with operculum extremely elongated distally (rod-like) and sparsely pilose (Fig. 33d).

Comments: *S. rotundatum* is a widespread species in South Africa (Hamer 1998), so easily identifiable that the holotype has never been re-examined prior to this study. Our observations generally indicate that *S. rotundatum auct.* is conspecific with the holotype. However, we have noticed certain discrepancies in the structure of the endotergum of the holotype and non-type material. This mainly concerns the cuticular pattern of the marginal ridge, which can be inconspicuous in some specimens.

We also confirm the synonymy established by Silvestri (1910), as the types of *viride* and *pubescens* also prove to represent *rotundatum auct.*

As *S. rotundatum*, the type species of *Sphaerotherium*, appears indeed to possess only four sensory cones on antennomere 8, this is of additional nomenclatural importance. This means that *Oligaspis* Wood, 1865, with *Oligaspis punticeps* Wood. 1865 as type-species (see next paragraph), *Neobournellum* Attems, 1908 (see above under *Sphaerotherium compressum*) and *Tetraconosoma* Verhoeff, 1924, with *Sphaerotherium weberii* Silvestri, 1910 as type-species, are to be confirmed here as representing strict junior subjective synonyms of *Sphaerotherium s. str*. To avoid the introduction of a new genus-group name, e.g. the invalidly proposed *Plethoconium* (cf. Attems 1943; Jeekel 1970; Hoffman 1980) to replace the subgeneric name *Sphaerotherium sensu auctorum*, we revive *Bournellum* De Saussure & Zehntner, 1902 as currently the earliest available substitute name (cf. Hoffman 1980), with the type species *Sphaerotherium retusum* C. L. Koch, 1847, showing ≥7 sensory cones on the last antennomere. However, a subgeneric division of *Sphaerotherium* based on the number of sensory cones on antennomere 8 alone is abandoned (see above under *S. dorsale*).



Figs 33a–h. *Sphaerotherium rotundatum* (a–e, ♀ holotype). a: apical part of antenna; b: lateral aspect; c: leg 9 with sensory seta; d: cyphopod; e: endotergum; f: posterior aspect of anterior telopod; g: posterior view of apical part of posterior telopod; h: anterior aspect of posterior telopods.

As regards the identity of *Oligaspis puncticeps* Wood, 1865*a*, the decision has been made to select a neotype because the holotype that was claimed to have been deposited in the collection of the Academy of Natural Sciences in Philedalphia (Wood 1865*a*) is presumably lost (Hoffman, in litt.). Based on the original description (Wood 1865*a*) and illustrations published elsewhere (Wood 1865*b*), there is no doubt that the holotype represented a juvenile male possessing about 10 body segments and under-developed telopods. The only useful information contained in the description and drawings concerns the type locality indicated as Port Natal (= Durban), the generally olive-brown colour with red-brown hind margins on the posterior tergites, the laterally swollen tibia of the posterior telopods, the gently sloping pygidium, and the smooth terga.

The neotype is an adult male kept in the NMSA collection, selected from among the samples identified by R. F. Lawrence as *Sphaerotherium rotundatum*. The male is 15 mm long and 7 mm wide, with the colour faded light brown, and with the hind margins of the posterior four tergites red-brown. The head is smooth, with sparse hairs, which are denser and longer towards the clypeus. The latter is somewhat punctate. The tergites have a smooth appearance, and the endotergum is as in Figs 6 and 33e, but the depressions behind the marginal ridge are not as obvious as illustrated. All other characters, including the telopods, the collum, the antennae, the leg coxae and tibial spines, are as described above for *rotundatum auct*.

The neotype comes from Umhlali, about 30 km north of Durban, collected in October 1960 by R. F. Lawrence, thus representing a strict topotype as well.

Sphaerotherium rugulosum Brandt, 1841

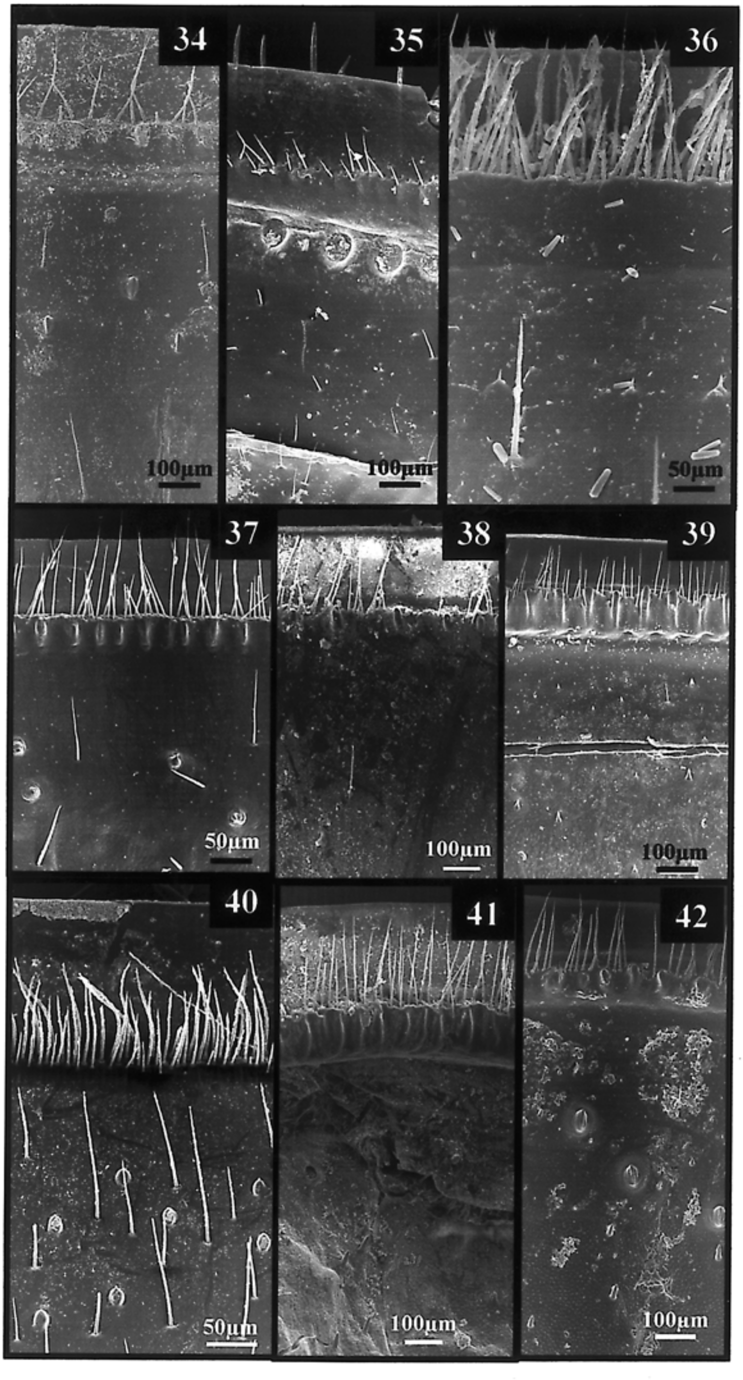
Material studied:
Type material: ♀ lectotype (badly preserved), South Africa, Caput bonae spei (Cape); ZISP.

Comments: The poor condition of the lectotype, with only a single midbody tergite representing the species being preserved, does not allow revision of *S. rugulosum* at the moment. Nevertheless, our observations of the structure of the endotergum show clear similarities with that of *S. punctatum*. This similarity was already mentioned by Butler (1873) who considered the two species as identical.

In the scope of a future generic revision, however, when more material becomes accumulated for study, the status of this and the other dubious species may finally be settled.

CONCLUSIONS

As a result of the current revisionary work, the following character matrix can be proposed (Tables 1 & 2). More studies, including further revisions, are necessary to refine and complete this matrix. Only this will finally allow proper assessment of the genus *Sphaerotherium*, its diversity, phylogeny and distribution. In addition, the names *Oligaspis*, *Neobournellum* and *Tetraconosoma* must be dropped and replaced by *Sphaerotherium s. str.*, while the subgeneric name *Sphaerotherium sensu auctorum* is to be replaced by *Bournellum*. However, a subgeneric division of *Sphaerotherium* based solely on the number of sensory cones on the ultimate antennomere is to be abandoned.



Figs 34–42. Endotergum (SEM) in *Sphaerotherium* species. 34. *S. compressum* (♀ paralectotype). 35. *S. dorsale* (♀ holotype). 36. *S. elongatum* (♀ paralectotype). 37. *S. giganteum* (♀ lectotype). 38. *S. intermedium* (♀ holotype). 39. *S. lichtensteinii* (♀ paralectotype). 40. *S. obtusum* (♀ holotype). 41. *S. punctatum* (♀ lectotype). 42. *S. punctulatum* (♂ lectotype).

TABLE 1.

Character matrix for the species revised in this paper.

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**1**	**01**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
compressum	0	1	1	0	1	1	0	3	1	0	2	0	0	0	0	0	1	
dorsale	1	1	3	0	1	1	1	1	0	0	1	0	0	1	0	0	1	
elongatum	1	0	2	1	2	0	0	3	0	0	3	0	0	2	2	0	2	
giganteum	1	0	2	0	0	1	0	3	1	0	0	1	0	1	0	1	0	
intermedium	0	1	0	0	0	1	0	3	1	0	?	?	?	?	?	1	0	
lichtensteinii	0	1	2	0	1	1	0	1	0	0	?	?	?	?	?	0	1	
obtusum	1	0	2	1	0	0	0	3	1	0	3	1	1	2	1	1	1	
punctatum	1	1	2	0	1	1	0	3	0	0	?	?	?	?	?	0	1	
punctulatum	1	0	1	0	0	1	0	3	0	0	0	0	1	2	1	0	0	
rotundatum	0	0	0	0	2	0	1	3	0	1	0	0	1	1	1	0	2	

TABLE 2.

List of characters used in Table 1.

	Description of characters	**Code**
1	Number of sensory cones on apical antennomere	<5 (0); >5 (1)
2	Median keel on tergal surface	absent (0); present (1)
3	Dorsal setae on tergites	absent (0); sparse (1); small and dense (2); long and dense, furry (3)
4	Row of marginal bristles	one row (0); several rows (1)
5	Marginal bristles	smooth (0); scaly (1); pinnate (2)
6	Callosities of marginal ridge	absent (0); present (1)
7	Cuticular patterns	absent (0); present (1)
8	Intersegmental membrane	neither cones nor setae (0); with cones (1); with setae (2); with cones and setae (3)
9	Coxa of legs	without lobe (0); with lobe (1)
10	Tibia of legs	without spines above (0); with two spines above (1)
11	Pygidium of male	No peculiarities (0); with a tail of bristles (2); with an elevated margin (3)
12	Coxa 2 of male	without lobe (0); with a lobe (1)
13	Anterior telopod	tarsus not divided (0); tarsus divided (1)
14	Tibial process of posterior telopod	No finger-shaped lobe (0); one finger-shaped lobe (1); more than one finger-shaped lobe (2)
15	Tarsal process of posterior telopod	undivided (0); divided (1)
16	Coxa 2 of female	without lobe (0); with lobe (1)
17	Operculum of cyphopod	triangular (0); rounded (1); rod-shaped (2)

Considering the new synonymies established here, the genus *Sphaerotherium* presently comprises at least 54 valid species. Although some further synonymies are very likely to become revealed in future studies, the genus *Sphaerotherium* will definitely remain one of the most species-rich and conspicuous elements of the southern African biota. Furthermore, already available museum collections still harbour numerous presumably new congeners to be described.

CATALOGUE OF CURRENTLY ACCEPTED *SPHAEROTHERIUM* SPECIES

As a result of the above revisionary work, the following updated catalogue can be proposed (cf. Hamer 1998), where bold-faced italicised names are the *Sphaerotherium* species or subspecies hitherto considered valid, with those marked by an asterisk are redescribed in the present paper. The repository acronyms and type locality are given for each species when available. (D) stands for a description or redescription, while (L) for a mere mention.

1. *Sphaerotherium alticola* Schubart, 1958
Sphaerotherium (*Tetraconosoma*) *alticola* Schubart, 1958: 69 (D)
Sphaerotherium (*Tetraconosoma*) *alticola* – Hamer 1998: 15 (L)
Type material: MZLU.
Type locality: Lesotho: Mt. Morosi, 15 miles NE Quthing, top plateau.
2. *Sphaerotherium apicale* Silvestri, 1910
Sphaerotherium apicale Silvestri, 1910: 217 (D)
Sphaerotherium apicale – Attems 1928: 229 (L)
Sphaerotherium (*Sphaerotherium*) *apicale* – Schubart 1958: 93 (L); Hamer 1998: 15 (L)
Types: IEPN.
Type locality: Mozambique: Maputo.
3. *Sphaerotherium boerium* Silvestri, 1910
Sphaerotherium boerium Silvestri, 1910: 219 (D)
Sphaerotherium boerium – Attems 1928: 229 (L)
Sphaerotherium (*Sphaerotherium*) *boerium* – Schubart 1958: 93 (L); Hamer 1998: 15 (L)
Type material: IEPN.
Type locality: RSA: Gauteng: Pretoria.
4. *Sphaerotherium capense* Schubart, 1958
Sphaerotherium (*Tetraconosoma*) *capense* Schubart, 1958: 48 (D)
Sphaerotherium (*Tetraconosoma*) *capense* – Hamer 1998: 15 (L)
Sphaerotherium monticola Pocock, 1895: 410 (D), synonymy, with qualifications though, proposed in Schubart 1958: 50
Type material: MZLU.
Type locality: RSA: W. Cape: Table Mtn, Blinkwater Ravine.
5. *Sphaerotherium cinctellum* Silvestri, 1910
Sphaerotherium cinctellum Silvestri, 1910: 191 (D)
Sphaerotherium cinctellum – Attems 1928: 222 (D), 1937: 464 (D); Lawrence 1987: 113 (L)
Sphaerotherium (*Tetraconosoma*) *cinctellum* – Schubart 1958: 86 (D); Hamer 1998: 16 (L)
Type material: IEPN.
Type locality: RSA: W. Cape: Knysna.
6. *Sphaerotherium civicum* Attems, 1928
Sphaerotherium civicum Attems, 1928: 231 (D)
Sphaerotherium (*Sphaerotherium*) *civicum* – Schubart 1958: 88 (L); Hamer 1998: 16 (L)
Type material: SAMC.
Type locality: RSA: E. Cape: Burgersdorp.
7. *Sphaerotherium commune* Attems, 1928
Sphaerotherium commune Attems, 1928: 218 (D)
Sphaerotherium (*Tetraconosoma*) *commune* – Schubart 1958: 58 (L); Hamer 1998: 16 (L)
Type material: SAMC.
Type locality: Not specified.
8. ****Sphaerotherium compressum*** Brandt, 1833

Sphaerotherium compressum Brandt, 1833: 198 (D)
Zephronia compressa – Gervais 1837: 9 (L), 1847: 77 (D); Deshayes & Milne Edwards 1838: 47 (L); Lucas 1842: 521 (D)
Sphaerotherium compressum – Brandt 1841*a*: 360 (D), 1841*b*: 176 (D); C. L. Koch 1847: 99 (L), 1863: 45 (D); Butler 1873: 175 (L); Silvestri 1910: 199 (D); Moritz & Fischer 1973: 368 (L); Golovatch & Hoffman 2001: 238 (L)
Sphaerotherium Klugii* (sic) Brandt, 1841*a*: 361 (D), **syn. n.
Sphaerotherium Klugii (sic) – Brandt 1841*b*: 177 (D)
Zephronia Klugii (sic) – Gervais 1847: 79 (D)
Sphaerotherium klugii – Butler 1873: 176 (D); Golovatch & Hoffman 2001: 238 (L)
Sphaerotherium compressum klugii – Silvestri 1910: 201 (D)
Sphaerotherium repulsum* Karsch, 1881: 28 (D), **syn. n.
Sphaerotherium repulsum – Moritz & Fischer 1973: 369 (L)
Bournellum trichopygum* Attems, 1908: 424 (D), **syn. n.
Sphaerotherium trichopygum – Attems 1928: 221 (D); Moritz & Fischer 1973: 370 (L)
Sphaerotherium (*Tetraconosoma*) *trichopygum* – Schubart, 1958: 56 (D); Hamer 1998: 19 (L)
**Sphaerotherium ancillare* Attems, 1928: 225 (D)
Sphaerotherium (*Tetraconosoma*) *ancillare* – Schubart 1958: 86 (L); Hamer 1998: 15 (L), **syn. n.**
Type material: ZMB 62, ZISP.
Type locality: RSA: ‘Promontorium Bonae Spei’ (Cape).

9. *Sphaerotherium coniferum* Silvestri, 1910
Sphaerotherium coniferum Silvestri, 1910: 213 (D)
Sphaerotherium coniferum – Attems 1928: 230 (D)
Sphaerotherium (*Sphaerotherium*) *coniferum* – Schubart 1958: 93 (L); Hamer 1998: 16 (L)
Type material: IEPN.
Type locality: Mozambique: Maputo.

10. *Sphaerotherium convexitarsum* Silvestri, 1910
Sphaerotherium convexitarsum Silvestri, 1910: 198 (D)
Sphaerotherium convexitarsum – Attems 1928: 217 (L)
Sphaerotherium (*Tetraconosoma*) *convexitarsum* – Schubart 1958: 50 (L); Hamer 1998: 16 (L)
Type material: IEPN.
Type locality: RSA: E. Cape: Port Elizabeth.

11. *Sphaerotherium dicrothrix* Attems, 1928
Sphaerotherium dicrothrix Attems, 1928: 232 (D)
Sphaerotherium (*Sphaerotherium*) *dicothrix* (sic) – Schubart 1958: 87 (L)
Sphaerotherium (*Sphaerotherium*) *dicrothrix* – Hamer 1998: 16 (L)
Type material: SAMC.
Type locality: RSA: LP: Acornhoek.

12. *Sphaerotherium dinogonum* Silvestri, 1910
Sphaerotherium dinogonum Silvestri, 1910: 210 (D)
Sphaerotherium dinogonum – Attems 1928: 226 (L)
Sphaerotherium (*Sphaerotherium*) *dinogonum* – Schubart 1958: 94 (L); Hamer 1998: 16 (L)
Type material: IEPN.
Type locality: RSA: W. Cape: Knysna.

13. ****Sphaerotherium dorsale*** (Gervais, 1847)
Zephronia dorsalis Gervais, 1847: 79 (D)
**Sphaerotherium retusum* C. L. Koch, 1847: 99 (D), synonymised by Attems 1928: 227
Zephronia puverea White, 1859: 405 (D), synonymised by Schubart 1958: 98
Sphaerotherium retusum – C. L. Koch 1863: 42 (D); Bourne 1885: 162 (D)
Sphaerotherium dorsale – Porat 1872: 5 (D); Silvestri 1910: 205 (D); Attems 1928: 227 (D), 1934: 464 (D); Lawrence 1953: 77 (L), 1987: 110; 112 (L); Manton 1954: 299 (D); Schubart 1958: 98 (D); Haacker 1968: 454 (D); Hamer 1998: 16 (L)
Bournellum retusum – De Saussure & Zehntner 1902: 22 (D)
Type material: MHNP.
Type locality: Unknown.

14. *Sphaerotherium dorsaloide* Silvestri, 1910
Sphaerotherium dorsaloide Silvestri, 1910: 189 (D)
Sphaerotherium dorsaloide – Attems 1928: 225 (D); Lawrence 1953: 88; 168 (L); 223 (D)
Sphaerotherium (*Tetraconosoma*) *dorsaloide* – Schubart 1958: 80 (D); Hamer 1998: 16 (L)
Type material: IEPN.
Type locality: RSA: W. Cape: Knysna.

15. ***Sphaerotherium elongatum** Brandt, 1833

Sphaerotherium elongatum Brandt, 1833: 199 (D)

Zephronia elongata – Gervais 1837: 9 (L), 1847: 80 (D); Deshayes & Milne Edwards 1838: 47 (L); Lucas 1842: 522 (D)

Sphaerotherium elongatum – Brandt 1841*a*: 362 (D), 1841*b*: 178 (D); Newport 1844: 10 (L); C. L. Koch 1847: 98 (L), 1863: 32 (D); Buttler 1873: 176 (L); Moritz & Fischer 1973: 368 (L); Golovatch & Hoffman 2001: 238 (L)

Sphaerotherium microstictum* Brandt, 1841*a*: 362 (D), **syn. n.

Sphaerotherium microstictum – Brandt 1841*b*: 178 (D); Butler 1873: 173 (D); Golovatch & Hoffman 2001: 239 (L)

Zephronia microsticta – Gervais 1847: 80 (D)

Type material: ZISP, ZMB 60.

Type locality: RSA: 'Caput Bonae Spei' (Cape).

16. *Sphaerotherium eremita* Attems, 1928

Sphaerotherium eremita Attems, 1928: 229 (D)

Sphaerotherium (*Sphaerotherium*) *eremita* – Schubart 1958: 93 (L); Hamer 1998: 17 (L)

Type material: SAMC.

Type locality: RSA: W. Cape: Table Mtn, Newlands.

17. *Sphaerotherium eucalyptophilum* Schubart, 1958

Sphaerotherium (*Tetraconosoma*) *eucalyptophilum* Schubart, 1958: 60 (D)

Sphaerotherium (*Tetraconosoma*) *eucalyptophilum* – Hamer 1998: 17 (L)

Type material: MZLU.

Type locality: RSA: LP: Soutpansberg, Punch Bowl 1.6 miles NNE Louis Trichardt.

18. *Sphaerotherium fulvum* Schubart, 1958

Sphaerotherium (*Tetraconosoma*) *fulvum* Schubart, 1958: 67 (D)

Sphaerotherium (*Tetraconosoma*) *fulvum* – Hamer 1998: 17 (L)

Type material: MZLU.

Type locality: RSA: E. Cape: Zuurberg Pass, 15 miles N Addo.

19. ***Sphaerotherium giganteum** Porat, 1872

Sphaerotherium giganteum Porat, 1872: 8 (D)

Sphaerotherium giganteum – Silvestri 1910: 212 (D); Attems 1928: 235 (D), 1934: 465 (D); Manton 1954: 299 (L); Lawrence 1953: 44; 99 (L), 1954: 170 (L), 1987: 109 (D), 112; 113; 114 (L)

Sphaerotherium (*Sphaerotherium*) *giganteum* – Schubart 1958: 92 (L); Hamer 1998: 17 (L)

Type material: SMNH.

Type locality: RSA: 'Caffraria'.

20. *Sphaerotherium granulatum* Pocock, 1895

Sphaerotherium granulatum Pocock, 1895: 410 (D)

Sphaerotherium granulatum – Silvestri 1910: 196 (D); Attems 1928: 217 (D)

Sphaerotherium (*Tetraconosoma*) *granulatum* – Schubart 1958: 50 (L); Hamer 1998: 17 (L)

Type material: NHML.

Type locality: RSA: E. Cape: Port Elizabeth.

21. *Sphaerotherium hanstroemi* Schubart, 1958

Sphaerotherium (*Tetraconosoma*) *hanströmi* (sic) Schubart, 1958: 62 (D)

Sphaerotherium (*Tetraconosoma*) *hanströmi* (sic) – Hamer 1998: 17 (L)

Types: MZLU.

Type locality: RSA: KZN: Pietermaritzburg, Town Bush.

22. ***Sphaerotherium intermedium** Porat, 1872

Sphaerotherium intermedium Porat, 1872: 8 (D)

Sphaerotherium intermedium – Silvestri 1910: 202 (D); Attems 1928: 222 (L)

Sphaerotherium (*Tetraconosoma*) *intermedium* – Schubart 1958: 50 (L); Hamer 1998: 17 (L)

Type material: SMNH.

Type locality: RSA: 'Caput Bonae Spei' (Cape).

23. *Sphaerotherium kitharistes* Attems, 1928

Sphaerotherium kitharistes Attems, 1928: 216 (D)

Sphaerotherium (*Tetraconosoma*) *kitharistes* – Schubart 1958: 78 (L); Hamer 1998: 17 (L)

Type material: SAMC.

Type locality: Mozambique: Macequece.

24. *Sphaerotherium krugeri* Lawrence, 1966

Sphaerotherium krugeri Lawrence, 1966: 242 (D)

Sphaerotherium krugeri – Hamer 1998: 17 (L)

Type material: NMSA.

Type locality: RSA: KNP: Gornondwane.

25. ***Sphaerotherium lichtensteinii*** Brandt, 1833

Sphaerotherium Lichtensteinii (sic) Brandt, 1833: 199 (D)

Zephronia Lichtenteinii (sic) – Gervais 1837: 9 (L), 1847: 78 (D); Deshayes & Milne Edwards 1838: 47 (L); Lucas 1842: 521 (D)

Sphaerotherium Lichtensteinii (sic) – Brandt 1841*a*: 361 (D), 1841*b*: 177 (D); C. L. Koch 1847: 99 (L), 1863: 33 (D)

Sphaerotherium lichtensteinii – Butler 1873: 174 (L); Moritz & Fischer 1973: 369 (L); Jeekel 2001: 32 (L); Golovatch & Hoffman 2001: 239 (L)

non *Sphaerotherium Lichtensteinii* (sic) – Tömösvary 1885: 68 (L); Daday 1889: 141 (L)

Type material: ZISP, ZMB 63.

Type locality: RSA: 'Caput Bonae Spei' (Cape).

26. *Sphaerotherium mahaium* Schubart, 1958

Sphaerotherium (*Tetraconosoma*) *mahaium* Schubart, 1958: 54–56 (D)

Sphaerotherium (*Tetraconosoma*) *mahaium* – Hamer 1998: 17 (L)

Type material: MZLU.

Type locality: RSA: KZN: Drakensberg, RNNP, Mahai River, the Cascades.

27. *Sphaerotherium millepunctatum* Attems, 1928

Sphaerotherium millepunctatum Attems, 1928: 219 (D)

Sphaerotherium millepunctatum – Attems 1934: 265 (D)

Sphaerotherium (*Tetraconosoma*) *millepunctatum* – Schubart 1958: 46 (L); Hamer 1998: 17 (L)

Type material: SAMC.

Type locality: Mozambique: Masiene nr Chai Chai.

28. *Sphaerotherium modestum* Attems, 1928

Sphaerotherium modestum Attems, 1928: 230 (D)

Sphaerotherium (*Sphaerotherium*) *modestum* – Schubart 1958: 93 (L); Hamer 1998: 17 (L)

Type material: SAMC.

Type locality: RSA: LP: Soutpansberg Distr., 20 miles E Pietersburg.

29. *Sphaerotherium narcissei* Alderweireldt, 1997

Sphaerotherium narcissei Alderweireldt, 1997: 53 (D)

Sphaerotherium narcissei – Hamer 1998: 18 (L)

Type material: MRAC.

Type locality: Zimbabwe: Melsetter, 64 km N Chipinga.

30. *Sphaerotherium nigritarse* Schubart, 1958

Sphaerotherium (*Tetraconosoma*) *nigritarse* Schubart, 1958: 81 (D)

Sphaerotherium (*Tetraconosoma*) *nigritarse* – Hamer 1998: 18 (L)

Type material: MZLU.

Type locality: RSA: W. Cape: Hermanus.

31. ***Sphaerotherium obtusum*** C. L. Koch, 1847

Sphaerotherium obtusum C. L. Koch, 1847: 98 (D)

Sphaerotherium obtusum – C. L. Koch 1863: 5 (D); Bourne 1885: 162 (D); Moritz & Fischer 1973: 369 (L)

Sphaerotherium grossum* C. L. Koch, 1847: 98 (D), **syn. n.

Sphaerotherium grossum – C. L. Koch 1863: 5 (D); Butler 1873: 176 (L); Moritz & Fischer 1973: 369 (L)

Bournellum obtusum – De Saussure & Zehntner 1902: 21 (D)

Type material: ZMB.

Type locality: RSA: 'Caput Bonae Spei' (Cape).

32. *Sphaerotherium perbrincki* Schubart, 1958

Sphaerotherium (*Tetraconosoma*) *perbrincki* Schubart, 1958: 51 (D)

Sphaerotherium (*Tetraconosoma*) *perbrincki* – Hamer 1998: 18 (L)

Type material: MZLU.

Type locality: RSA: KZN: Drakensberg, RNNP, Gudu Falls area.

33. *Sphaerotherium permodestum* Silvestri, 1910

Sphaerotherium permodestum Silvestri, 1910: 214 (D)

Sphaerotherium permodestum – Attems 1928: 231 (L)

Sphaerotherium (*Sphaerotherium*) *permodestum* – Schubart 1958: 94 (L); Hamer 1998: 18 (L)

Type material: IEPN.

Type locality: RSA: Transvaal, no details.

34. *Sphaerotherium pinnatum* Schubart, 1958

Sphaerotherium (*Tetraconosoma*) *pinnatum* Schubart, 1958: 76 (D)

Sphaerotherium (*Tetraconosoma*) *pinnatum* – Hamer 1998: 18 (L)

Type material: MZLU.

Type locality: Not specified.

35. ***Sphaerotherium plagiarium*** Silvestri, 1910

Sphaerotherium plagiarium Silvestri, 1910: 193 (D)

Sphaerotherium plagiarium – Attems 1928: 224 (D)

Sphaerotherium (*Tetraconosoma*) *plagiarium* – Schubart 1958: 86 (L); Hamer 1998: 18 (L)

Types: IEPN.

Type locality: RSA: W. Cape: Knysna.

36. *****Sphaerotherium punctatum*** Brandt, 1833

Sphaerotherium punctatum Brandt, 1833: 199 (D)

Zephronia punctata – Gervais 1837: 9 (L), 1847: 81 (D); Deshayes & Milne Edwards 1838: 47 (L); Lucas 1842: 522 (D)

Sphaerotherium punctatum – Brandt 1841*a*: 362 (D), 1841*b*: 179 (D); Newport 1844: 10 (L); C. L. Koch 1847: 98 (L), 1863: 43 (D); Butler 1873: 174 (D); Moritz & Fischer 1973: 369 (L); Lawrence 1987: 113; 114 (L); Golovatch & Hoffman 2001: 239 (L)

Type material: ZMB 56.

Type locality: RSA: 'Caput Bonae Spei' (Cape).

37. ****Sphaerotherium punctulatum*** Brandt, 1841

Sphaerotherium punctulatum Brandt, 184l*a*: 362 (D)

Sphaerotherium punctulatum – Brandt 1841*b*: 179 (D); Porat 1872: 8 (D); Butler 1873: 173 (D); Silvestri 1910: 216 (D); Attems 1928: 234 (D), 1934: 465 (D); Warren 1934: 382 (D); Golovatch & Hoffman 2001: 239 (L); Van den Spiegel 2002: 171 (D)

Zephronia punctulata – Gervais 1847: 81 (D)

Sphaerotherium (*Sphaerotherium*) *punctulatum* – Schubart 1958*:* 91 (D); Hamer 1998: 18 (L)

Type material: ZISP.

Type locality: RSA: 'Caput Bonae Spei' (Cape).

38. ****Sphaerotherium rotundatum*** Brandt, 1833

Sphaerotherium rotundatum Brandt, 1833: 198 (D)

Zephronia rotundata – Gervais 1837: 9 (L), 1847: 77 (D); Deshayes & Milne Edwards 1838: 47 (L); Lucas 1842: 521 (D)

Sphaerotherium rotundatum – Brandt 1841*a*: 360 (D), 1841*b*: 175 (D); C. L. Koch 1847: 99 (L), 1863: 44 (D); Silvestri 1910: 184 (D); Attems 1928: 214 (D), 1934: 464 (D); Moritz & Fischer 1973: 370 (L); Golovatch & Hoffman 2001: 239 (L)

Oligaspis puncticeps* Wood 1865*a*: 173 (D), **syn. n.

**Sphaerotherium pubescens* Porat, 1872: 7 (D), synonymised by Silvestri 1910: 184

**Sphaerotherium viride* Porat, 1872: 6 (D), synonymised by Silvestri 1910: 184

Sphaerotherium (*Tetraconosoma*) *rotundatum* – Schubart 1958: 75 (L); Hamer 1998: 18 (L)

Type material: ZMB 61.

Type locality: RSA: 'Caput Bonae Spei' (Cape).

39. ***Sphaerotherium rudebecki*** Schubart, 1958

Sphaerotherium (*Sphaerotherium*) *rudebecki* Schubart, 1958: 88 (D)

Sphaerotherium (*Sphaerotherium*) *rudebecki* – Hamer 1998: 18 (L)

Type material: MZLU.

Type locality: Lesotho: Quthing.

40. ****Sphaerotherium rugulosum*** Brandt, 1841

Sphaerotherium rugulosum Brandt, 1841*a*: 363 (D)

Sphaerotherium rugulosum – Brandt 1841*b*: 179 (D); Butler 1873: 175 (D); Golovatch & Hoffman 2001: 239 (L)

Zephronia rugulosa – Gervais 1847: 82 (D)

Type material: ZISP.

Type locality: RSA: 'Caput Bonae Spei' (Cape).

41. ***Sphaerotherium selindum*** Alderweireldt, 1997

Sphaerotherium (*Tetraconosoma*) *selindum* Alderweireldt, 1997: 53 (D)

Type material: MRAC.

Type locality: Zimbabwe: Mount Selinda, Chirinda Forest.

42. ***Sphaerotherium similare*** Schubart, 1958

Sphaerotherium (*Tetraconosoma*) *similare* Schubart, 1958: 82 (D)

Sphaerotherium (*Tetraconosoma*) *similare* Hamer, 1998: 18 (L)

Type material: MZLU.

Type locality: RSA: E. Cape: Tsitsikama Forest.

43. ***Sphaerotherium solitarium*** Attems, 1928

Sphaerotherium solitarium Attems, 1928: 233 (D)

Sphaerotherium (*Sphaerotherium*) *solitarium* – Schubart 1958: 91 (L); Hamer 1998: 19 (L)
Type material: SAMC.
Type locality: RSA: LP: Shilowane nr Leydsdorp.

44. *Sphaerotherium spinatum* Silvestri, 1910
Sphaerotherium spinatum Silvestri, 1910: 187 (D)
Sphaerotherium spinatum – Attems 1928: 213 (D)
Sphaerotherium (*Tetraconosoma*) *spinatum* – Schubart 1958: 60 (L); Hamer 1998: 19 (L)
Type material: IEPN.
Type locality: RSA: E. Cape: Port Elizabeth.

45. *Sphaerotherium steppense* Schubart, 1958
Sphaerotherium (*Tetraconosoma*) *steppense* Schubart, 1958: 65 (D)
Sphaerotherium (*Tetraconosoma*) *steppense* – Hamer 1998: 19 (L)
Type material: MZLU.
Type locality: RSA: E. Cape: 15 miles S Middleton.

46. *Sphaerotherium subdorsale* Silvestri, 1910
Sphaerotherium subdorsale Silvestri, 1910: 208 (D)
Sphaerotherium subdorsale – Attems 1928: 228 (D)
Sphaerotherium (*Sphaerotherium*) *subdorsale* – Schubart 1958: 95 (D); Hamer 1998: 19 (L)
Type material: IEPN.
Type locality: RSA: Transvaal, no details.

47. *Sphaerotherium submite* Silvestri, 1910
Sphaerotherium submite Silvestri, 1910: 204 (D)
Sphaerotherium submite – Attems 1928: 222 (L)
Sphaerotherium (*Tetraconosoma*) *submite* – Schubart 1958: 58 (L); Hamer 1998: 19 (L)
Type material: IEPN.
Type locality: RSA: W. Cape: Knysna.

48. *Sphaerotherium tenuitarse* Silvestri, 1910
Sphaerotherium tenuitarse Silvestri, 1910: 186 (D)
Sphaerotherium tenuitarse – Attems 1928: 215 (D), 1934: 464 (D)
Sphaerotherium (*Tetraconosoma*) *tenuitarse* – Schubart 1958: 76 (L); Hamer 1998: 19 (L)
Type material: IEPN.
Type locality: RSA: W. Cape: Knysna.

49. *Sphaerotherium tomentosum* Schubart, 1958
Sphaerotherium (*Sphaerotherium*) *tomentosum* Schubart, 1958: 96 (D)
Sphaerotherium (*Sphaerotherium*) *tomentosum* – Hamer 1998: 19 (L)
Type material: MZLU.
Type locality: RSA: KZN: Drakensberg, RNNP, Gudu Falls.

50. *Sphaerotherium transzambeziacum* Jocqué, 1984
Sphaerotherium (*Tetraconosoma*) *transzambeziacum* Jocqué, 1984: 67 (D)
Type material: MRAC.
Type locality: Malawi, Mt. Mulanje, Tchuchila, Nambiti.

51. *Sphaerotherium tuberosum* Attems, 1928
Sphaerotherium tuberosum Attems, 1928: 220 (D)
Sphaerotherium (*Tetraconosoma*) *tuberosum* – Schubart 1958: 56 (D); Hamer 1998: 19 (L)
Type material: SAMC
Type locality: RSA: Cape Province; W. Cape, Table Mtn; Zoekmakaar, N. Transvaal. No lectotype has heretofore been selected (cf. Hamer 1998).

52. *Sphaerotherium tzitzikamum* Schubart, 1958
Sphaerotherium (*Tetraconosoma*) *tzitzikamum* Schubart, 1958: 70 (D)
Sphaerotherium (*Tetraconosoma*) *tzitzikamum* – Hamer 1998: 19 (L)
Type material: MZLU.
Type locality: RSA: E. Cape: Tsitsikama Forest, Stormsriver.

53a. *Sphaerotherium weberii* Silvestri, 1910
Sphaerotherium Weberii (sic) Silvestri, 1910: 194 (D)
Sphaerotherium weberi (sic) – Attems 1928: 219 (D)
Sphaerotherium (*Tetraconosoma*) *weberii* – Schubart, 1958: 43 (D); Hamer 1998: 19 (L)
Type material: IEPN.
Type locality: RSA: W. Cape: Table Mtn.

53b. *Sphaerotherium weberii afoveatum* Schubart, 1958
Sphaerotherium (*Tetraconosoma*) *weberii afoveatum* Schubart, 1958: 46 (D)
Sphaerotherium (*Tetraconosoma*) *weberii afoveatum* – Hamer 1998: 20 (L)

Type material: MZLU.
Type locality: RSA: W. Cape: Table Mtn.

54. *Sphaerotherium zuluense* Schubart, 1958
Sphaerotherium (*Tetraconosoma*) *zuluense* Schubart, 1958: 74 (D)
Sphaerotherium (*Tetraconosoma*) *zuluense* – Hamer 1998: 20 (L)
Type material: MZLU.
Type locality: RSA: KZN: Hluhluwe Game Reserve.
Sphaerotherium species *incertae sedis* (after Attems 1928; Schubart 1958)
Sphaerotherium monticola Pocock, 1895
Sphaerotherium nigrum Butler, 1873

ACKNOWLEDGEMENTS

We are most grateful to the following keepers involved: P. Bayliss (TMSA), J. Beccaloni (NHML), M. A. Cochrane (SAMC), J. Dunlop (ZMB), V. Krivokhatsky (ZISP), T. Kronestedt (SMNH), J. P. Mauriès (MNHN), and A. Ruiters (NMSA). Special thanks are due to R. L. Hoffman (Martinsville, Virginia, U.S.A.) for a critical review of an advanced draft and several important suggestions. Our thanks also go to N. Van Noppen for the numerous drawings prepared.

DVDS has been supported for this work through a grant from the EU programme "SYS-RESOURCE".

REFERENCES

Alderweireldt, M. P. 1997. Two new species of the genus *Sphaerotherium* Brandt, 1833 from Zimbabwe, together with some biogeographical notes (Diplopoda, Oniscomorpha, Sphaerotheriidae). *Myriapodologica* **4** (7): 51–57.

Attems, C. 1908. Die Myriopoden der Deutsche Südpolar-Expedition. *In*: Von Drygalski, ed., *Deutsche Südpolar-Expedition 1901–1903, Zoologie* **9**: 415–433.

——— 1928. The Myriopoda of South Africa. *Annals of the South African Museum* **26**: 1–431.

——— 1934. The Myriopoda of Natal and Zululand. *Annals of the Natal Museum* **7** (3): 459–522.

——— 1943. Neue Sphaerotheriden des Wiener Museums. *Annalen des Naturhistorischen Museums in Wien* **53** (2): 60–75.

Bourne, G. 1885. On the anatomy of *Sphaerotherium*. *Journal of the Linnean Society of London* **19**: 161–174.

Brandt, J. F. 1833. Tentaminum quorundam monographicorum Insecta Myriapoda Chilognatha Latreillii spectantium prodromus. *Bulletin de la Société Impériale des Naturalistes de Moscou* **6**: 194–209.

——— 1841*a*. Remarques critiques sur les espèces qui composent les genres *Sphaerotherium* et *Sphaeropoeus*, suivies d'une description de six espèces nouvelles des Sphaerothéries. *Bulletin scientifique publié par l'Académie Impériale des Sciences de St. Pétersbourg* **8**: 357–365.

——— 1841*b*. *Recueil de mémoires relatifs à l'ordre des Insectes Myriapodes et lus* à *l'Académie Impériale des Sciences de St. Pétersbourg*. Saint-Pétersbourg & Leipsik. 189 p.

Butler, A. G. 1873. A monographic revision of the genera *Zephronia* and *Sphaerotherium* with descriptions of new species. *Proceedings of the Zoological Society of London* **1873**: 172–182.

Daday, J. 1889. Myriopoda extranea Musaei Nationalis Hungarici. *Természetrajzi Füzetek* **12** (4): 115–156.

Deshayes, G. P. & Milne Edwards, H. 1838. Arachnides, Crustacés, Annelides, Cirrhipèdes. *In*: De Lamarck, J. B. P. A., ed., *Histoire naturelle des animaux sans vertèbres*. Paris:Baillière. **5**: 1–699.

De Saussure, H. & Zehntner, L. 1902. Myriapodes de Madagascar. *In*: Grandidier, A., ed., *Histoire physique, naturelle et politique de Madagascar* **27** (53): i–viii, 1–356.

Gervais, P. 1837. Etudes pour servir à l'histoire naturelle des Myriapodes. *Annales des Sciences naturelles* **7**: 1–26.

——— 1847. Myriapodes. *In*: Walckenaer, C. A. & Gervais, P., eds, *Histoire naturelle des Insectes. Aptères*. Paris: Roret. **4**: 31–623.

Golovatch, S. I. & Hoffman, R. L. 2001 (for 2000). On the diplopod taxa and type material of J. F. Brandt, with some new descriptions and identities (Diplopoda). *In*: Wytwer, J. & Golovatch, S. I., eds, *Progress in studies on Myriapoda and Onychophora*. *Fragmenta Faunistica* **43** (Supplement): 229–249.

HAACKER, U. 1968. Das Sexualverhalten von *Sphaerotherium dorsale* (Myriapoda, Diplopoda). *Verhandlungen der Deutschen Zoologischen Gesellschaft* **48**: 454–463.

HAMER, M. L. 1998. Check list of Southern African millipedes. *Annals of the Natal Museum* **39**: 11–82.

HOFFMAN, R. L. 1980 (for 1979). *Classification of the Diplopoda.* Genève: Muséum d'histoire naturelle.

JEEKEL, C. A. W. 1970. Nomenclator generum et familiarum Diplopodorum: A list of the genus and family-group names in the class Diplopoda from the 10th edition of Linnaeus, 1758, to the end of 1957. *Monografieën van de Nederlandse Entomologische Vereniging* **5**: i–xii, 1–412.

——— 1974. The group taxonomy and geography of the Sphaerotheriidae (Diplopoda). *Symposia of the Zoological Society of London* **32**: 41–52.

——— 2001. A bibliographic catalogue of the Asiatic Sphaerotheriida (Diplopoda). *Myriapod Memoranda* **3**: 5–38.

JOCQUÉ, R. 1984. Contribution to the knowledge of the mountain fauna of Malawi. 4: Diplopoda Sphaerotheriidae. *Revue de Zoologie africaine* **98** (1): 67–73.

KARSCH, F. 1881. Zur Formenlehre der pentazonen Myriopoden. *Archiv für Naturgeschichte* **47** (1): 19–35.

KOCH, C. L. 1847. System der Myriapoden, mit den Verzeichnissen und Berichtigungen zu Deutschlands Crustaceen, Myriapoden und Arachniden. *In*: Panzer, G. W. F. & Herrich-Schäffer, G. A. W., eds, *Kritische Revision der Insectenfaune Deutschlands*. Regensburg: Pustet. **3**: 1–270.

——— 1863. *Die Myriapoden getreu nach der Natur abgebildet und beschrieben*. Halle: Schmidt **1**: 1–134.

LAWRENCE, R. F. 1953. *The biology of the cryptic fauna of forests with special reference to the indigenous forests of South Africa*. Cape Town: A. A. Balkema.

——— 1954. Fluorescence in Arthropoda. *Journal of the Entomological Society of South Africa* **17** (2): 167–170.

——— 1966. The Myriapoda of the Kruger National Park. *Zoologica Africana* **2** (2): 225–262.

——— 1987. *The centipedes and millipedes of Southern Africa. A Guide*. Cape Town: A.A. Balkema.

LUCAS, M. 1842. *Histoire naturelle des Crustacés, des Arachnides et des Myriapodes*. Paris: Duménil.

MANTON, S. N. 1954. The evolution of arthropodan locomotory mechanisms. Part 4. The structure, habits and evolution of the Diplopoda. *Journal of the Linnean Society of London (Zoology)* **42**: 299–368.

MORITZ, M. & FISCHER, S.-CH. 1973. Die Typen der Myriapoden-Sammlung des Zoologischen Museums Berlin. I. Diplopoda. Teil 1: Polyxenida, Glomerida, Sphaerotheriida, Glomeridesmida, Polyzonida, Craspedosomatida (Striariidae, Trachysomatidae, Chamaesomatidae, Orobainosomatidae, Mastigophorophyllidae, Neoatractosomatidae,Verhoeffiidae, Heterolatzeliidae, Conotylidae, Diplomaragnidae). *Mitteilungen aus dem Zoologischen Museum in Berlin* **49** (2): 351–385.

NEWPORT, G. 1844. *List of the specimens of Myriapoda in the collection of the British Museum*. London: Taylor & Francis.

POCOCK, R. I. 1895. Descriptions of new genera of Zephroniidae, with brief preliminary diagnoses of some new species. *Annals and Magazine of Natural History* (6) **16**: 409–415.

PORAT, C. O. VON 1872. Myriopoda Africae australis, in Museo Regio Holmiae asservata, recensuit. *Öfversigt af Kongl. Vetenskaps-Akademiens Förhandlingar* **1872** (5): 3–46.

SCHUBART, O. 1958. Diplopoda 11: Oniscomorpha. *In*: Hanström, B., Brinck, P. & Rudebeck, G., eds, *South African Animal Life* **5**: 41–108.

SILVESTRI, F. 1910. Materiali per una revisione dei Diplopoda Oniscomorpha. I specie del genere *Sphaerotherium* dell'Africa meridionale a me note. *Bollettino del Laboratorio di Zoologia Generale Agraria della R. Scuola superiore d'Agricoltura in Portici* **4**: 180–220.

TÖMÖSVARY, E. 1885. Myriopoda a Joanne Xantus in Asia orientali collecta. Enumeravit speciesque novas descripsit. *Természetrajzi Füzetek* **9**: 63–72.

VAN DEN SPIEGEL, D. 2002. On the occurrence of *Sphaerotherium punctulatum* in Malawi (Diplopoda: Sphaerotheriidae). *Annales du Musée Royal de l'Afrique Centrale, Zoologie* **286**: 171–174.

VERHOEFF, K. W. 1924. Results of Dr. E. Mjöberg's Swedish Scientific Expedition to Australia 1910–1913. 34. Myriapoda: Diplopoda. *Arkiv för Zoologi* **16** (5): 1–142.

WARREN, E. 1934. On the male genital system and spermatozoa of certain millipedes. *Annals of the Natal Museum* **7** (3): 351–407.

WHITE, A. 1859. Spicilegia Apterologica. – I. Description of some Myriapoda of the genus *Zephronia*. (J. E. Gray), in the collection of the British Museum. *Annals and Magazine of Natural History* (3) **3**: 404–406.

WOOD, H. C. 1865*a*. New Polyzoniidae, Gervais. *Proceedings of the Academy of Natural Sciences of Philadelphia* **1865**: 172–173.

——— 1865*b*. The Myriapoda of North America. *Transactions of the American Philosophical Society, New Series* **13**: 137–248.